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# Incorporating User Data in Cross Boundary Trail Mangement: A case study of the foothills trail systemnear Wenatchee, WA

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# INCORPORATING USER DATA IN CROSS BOUNDARY TRAIL MANAGEMENT: A CASE STUDY OF THE FOOTHILLS TRAIL SYSTEM NEAR WENATCHEE, WA

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by

Beth Anna Macinko

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ABSTRACT

INCORPORATING USER DATA IN CROSS BOUNDARY TRAIL MANAGEMENT:

A CASE STUDY OF THE FOOTHILLS TRAIL SYSTEM

NEAR WENATCHEE, WA

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Land managers for areas where recreation occurs balance minimizing impacts on the landscape with providing recreation opportunities. Use characteristics including type of use, use frequency, and use patterns have been shown to influence the severity of landscape impacts from recreation. Collecting and incorporating user data is critical to effective recreation management. The Foothills trail system is a nonmotorized, day use trail system adjacent to the city of Wenatchee, Washington that crosses public and private properties. This thesis obtained data on user demographics, use characteristics, user perceptions, and spatial use patterns through a questionnaire administered through a mixed method sampling approach that resulted in 345 survey responses. Analysis of respondent data identified trail users as local, frequent, and long-time users who find trail conditions acceptable and report low levels of interpersonal conflict. A use pattern spatial component revealed overlap in high use trail segments among all methods of travel (hiking, biking, running, horseback riding). Management recommendations based on user data are discussed. This study identified management goals for each land owner and proposes an integrated approach to management planning for cross boundary trail systems that incorporates collecting and monitoring user data.

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I want to thank my family and friends for their support throughout these two years, especially Will Crowley for his constant encouragement. I would like to dedicate this thesis to the memory of George Macinko and Sam and Diane Rust, and to Mary Ann Macinko, who always supported and inspired me to pursue my interests.

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# CHAPTER I

# INTRODUCTION

## Problem

Resource managers of publicly accessible, protected lands are tasked with managing for multiple goals, which often include offering recreation opportunities in addition to preserving open space, providing habitat for wildlife, and protecting the natural resources of an area. Land management plans are created as documented strategies to achieve the established management goals. These management plans incorporate user-directed policies, such as restricting type of use or season of use, and site-directed policies, including trail construction and maintenance standards to mitigate impacts from recreation activities (Marion 2016).

Obtaining information about users and use levels is an important component to a relevant and informed management plan that will ensure ecological resources are protected. Recreation activities negatively impact soils, vegetation, water, and wildlife of the area in which they occur (Buckley 2004; Hammitt, Cole, and Monz 2015; Marion 2016). The severity of these impacts depends on the type of use, use characteristics, and biophysical characteristics of the landscape (Marion and Leung 2001; Monz et al. 2010; Pickering et al. 2010). Consequently, baseline data on user and use characteristics are important to collect to identify patterns and impacts and compare against ecological changes (Reynolds and Elson 1996; Cope, Doxford, and Probert 2000).

User data also provides an opportunity to assess how effective implemented management plans are in achieving their goals (Cope, Doxford, and Probert 2000). This

is especially key in areas where recreation activities occur across multiple land owner boundaries and management plans are not coordinated together. Managing across property and land manager boundaries brings additional challenges in coordinating visions and implementation plans for current and future land and trail management (Miller and Gershman 1998).

## Purpose

The Foothills trail system is a system of approximately 22 miles of non-motorized multi-use trails on the outskirts of Wenatchee, Washington (Figure 1). The trail system covers over 4,800 acres in the hills to the west of the city, and crosses through a patchwork of five different property ownerships: the City of Wenatchee (City), Chelan-County Public Utility District (PUD), Chelan-Douglas Land Trust (CDLT), and two private properties that have conservation easements that allow public access held by CDLT. The US Bureau of Land Management and Washington State Department of Natural Resources, and US Forest Service own parcels adjacent to the trail system (Chelan County 2014; Chelan-Douglas Land Trust 2017b). The Foothills have been informally used for recreation since the area was settled, and the trail system has seen increasingly organized management in the last two decades (City of Wenatchee 2007; The Trust for Public Land and CORE GIS 2010).

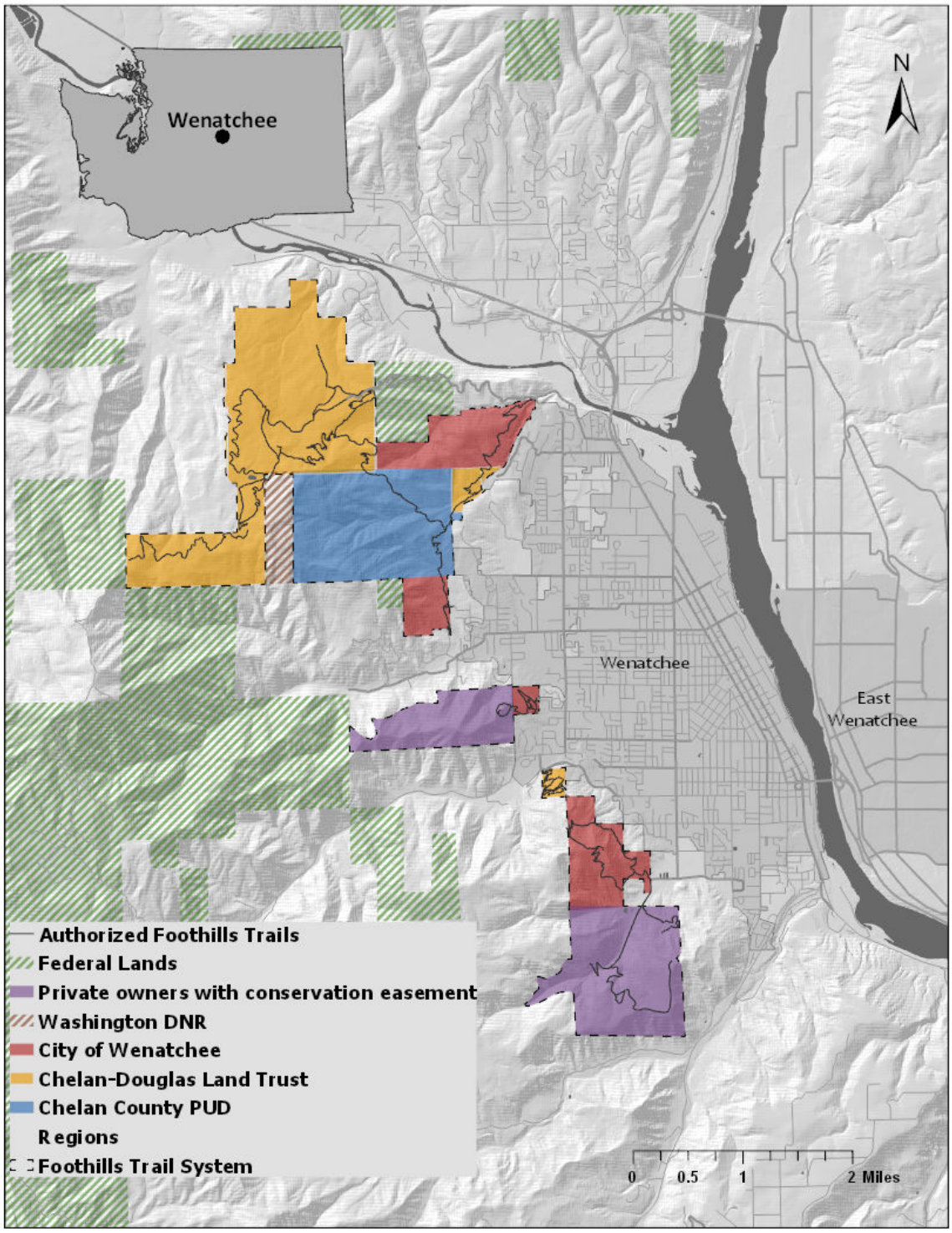


Figure 1 Foothills Trail System property ownership, map by author.
Data sources: Chelan County GIS, Chelan-Douglas Land Trust, Douglas County GIS, US Census TIGER/Line.

While the management goals of the various property owners overlap, differences in priorities affect the management of different sections of the trail system. The management plans of the City and CDLT directly acknowledge managing for different levels and types of use (Chelan-Douglas Land Trust 2011; City of Wenatchee Parks Recreation and Cultural Services Department 2017). However, there has been no systematic effort to collect baseline data to understand user characteristics and use patterns and how they vary throughout the system. User behaviors and preferences were initially incorporated in recreation management planning through community workshops before the trail system was created; however, ongoing recreation management has relied on observations by land managers (City of Wenatchee 2007; The Trust for Public Land and CORE GIS 2010; Beener et al. 2018).

The primary research questions this study aims to address are: 1) How do management goals by land owners along the cross boundary trail system compare? and 2) What are the types of trail use, patterns, and perceptions of users within this patchwork ownership and what are the resulting management implications?

## Objectives

This study collects information to fill the gap in baseline data about user characteristics and user experiences on the Foothills trails and analyzes the output both spatially and temporally in relation to landowner management goals. Specifically, the objectives of this study are to: (a) identify the different land owners and their management goals for the Foothills trail system; (b) create a questionnaire tool that can be adapted and replicated in future years to track trends and monitor issues and locations

of interest; (c) collect baseline information on user characteristics, use patterns, and user perceptions of conflicts and trail conditions throughout the Foothills trail system; and (d) analyze results of the user questionnaire to provide cohesive management policy and future monitoring recommendations.

## Significance

As populations increase within the rural/urban interface of Wenatchee and the Foothills trail network develops, management plans will have to adapt to reflect use levels and user preferences to meet goals of minimizing impact and providing desired recreation experiences. The field of recreation ecology has shown that impacts to the landscape vary depending on the level of use and characteristics of use in additional to landscape characteristics. Minimizing user impact is especially important due to the landscape characteristics of the Foothills area. Recreational activities on the slow-growing shrub-steppe vegetation and moderately erosive soils can have long term biophysical impacts. User-built, or unauthorized, trails are easy to create and hard to restore as vegetation grows back slowly, after being destroyed from trampling. An additional problem with unauthorized trails are that they are often created without consideration of drainage and can quickly become rutted or form trenches due to erosion.

In order to manage lands for the same outcomes, with likely increases in use frequency and possible changes in types of use, land managers will benefit from understanding current use and tracking changes in use patterns. CDLT, the primary manager of trail design and maintenance throughout the system, recognizes the need to

account for frequency and type of use in their trails guidelines and standards, yet no study has been conducted to collect the relevant use information.

Given the patchwork of multiple land owners with differing goals and cross-boundary recreation use, this study is also significant because it analyzes trail system user characteristics and perception against the framework of management goals of the Foothills trail property owners. This becomes even more significant when the individual management plans have different objectives and may require review, as is the case at one of the properties in this study, which will be elaborated on further in Chapter 3.

This study provides Foothills trail system land owners an analysis of current user data to inform management planning, establishes a replicable process for collecting use data in the future to identify trends in use, and evaluates the coordination of management goals in a collaborative management context.

## Chapter Progression

Chapter 2 reviews literature relating to management including land management across multiple ownerships, recreation management, and visitor monitoring practices. Chapter 3 describes the study area, the Foothills trail system, in terms of its biophysical and cultural context. Chapter 4 explains the methods used in this study including document research, the user survey component, and data analysis. Chapter 5 provides a summary of management goals obtained from document research, descriptive statistics for questionnaire results, and spatial analysis results. Chapter 6 gives policy and management recommendations to address issues identified in the results and concludes by suggesting areas for future research.

# CHAPTER II

# LITERATURE REVIEW

Outdoor recreation is increasing nationally and this trend is also occurring regionally in Washington State (Cordell, Betz, and Green 2008; Jostad, Schultz, and Chase 2017). This increase in use has resulted in management concerns about how the level of impact to the landscape is changing with increasing recreational use, and how resource managers need to account for changing use patterns in their management plans (Monz et al. 2010; D'Antonio et al. 2016).

Management is more complex for recreational trail systems that cross property boundaries as management goals of all landowners must be coordinated (Wright, Cordell, and Brown 1990; Miller and Gershman 1998; Brooks and Champ 2006). This literature review examines private land conservation, the management of natural areas over cross-boundary property ownerships, recreation management requirements and strategies, and user monitoring research efforts to inform recreation management.

## Private Land Conservation for Public Access

In the late 20th century, conservation and social justice movements emerged in the United States to protect open spaces adjacent to urban areas. The goal was to ensure that open space areas remained undeveloped to provide wildlife habitat, scenic view sheds, public access, and other ecosystem services (Mason 1994; Brewer 2003; Ryan and Hansel Walker 2004). Often these lands were held in private ownership and had been used for agriculture or resource extraction; as urban centers grew outward, these parcels

became the remaining open spaces. Desire to protect these lands is usually driven at the local level (Mason 1994; Ryan and Hansel Walker 2004). Formal protection of private properties can be achieved through conservation easements or the sale or donation of land to a local municipality, state agency, or private organization.

Conservation easements are agreements between property owners and a nonprofit organization or public agency in which a property is protected from development or certain uses. The property owner receives tax benefits and is free to sell or bequeath the land, but the easement remains under protection in effect in perpetuity (Land Trust Alliance 2016). Generally, easements are created for the protection of one or more features of the landscape such as wildlife habitat, scenic views, or other ecosystem services. The specific terms of what activities are allowed by the easement are defined by discussions between the property owner and easement holding entity (Poole 1993; Hocker 1996; Land Trust Alliance 2016). Easements often allow some level of public access (Brewer 2003; Land Trust Alliance 2016).

Property owners that want their lands to be conserved can also donate or sell their property outright to city, county, or state governments, or private non-profit organizations, provided the receiving entity has resources and interest to obtain and maintain the property (Land Trust Alliance 2016). Conservation easements and donation or purchase transactions are often facilitated by a local or national land trust organization that have the flexibility and resources to navigate the legalities of land transfer (Endicott 1993).

Land trusts have advantages over local, state, and federal agencies in that they can find more flexible and creative solutions to conserve natural areas (Endicott 1993;

Brewer 2003). At the same time, land trusts typically are small organizations, with limited budgets, and can struggle without strong leadership, partnerships, and community support (Brewer 2003). Successful land trusts work collaboratively and leverage partnerships with local governments, private landowners, and larger national land trusts to strategically preserve key properties for ecosystem connectivity or user access (Hocker 1996; Brewer 2003).

## Cross-boundary Land Management

Partnerships allow private and public land owners to pool their resources and expertise and protect larger amounts of land. However, each entity comes to the partnership with their own purpose and goals. Cross-boundary areas require coordinating management to ensure consistency and understanding is maintained across ownership boundaries (Miller and Gershman 1998).

The framework for the success of cross-boundary management recommends initiating dialogue with all stakeholders early on, anticipating potential conflicts and problems, identifying management goals, and evaluating potential solutions for the ability to achieve stakeholder goals and feasibility for implementation (Miller and Gershman 1998). If management goals for one or more land owners includes providing recreation opportunities, recreation management planning has to occur as part of the overall management planning process.

## Recreation Management Planning

Managing lands for recreation begins with determining management goals, which are informed by the land owner's purpose and directives, user preferences, and the

characteristics of the resource area (Pigram and Jenkins 2006). Management strategies can then be selected to meet management goals, with consideration to the recreation activities possible, structure of the area or recreation system, land owner's purpose and directives, and user preferences and attitudes (Pigram and Jenkins 2006; Manning 2014; Hammitt, Cole, and Monz 2015). Possible management strategies for recreation are discussed in greater detail in the following section. The chosen strategies are implemented and evaluated for effectiveness, any discrepancies should be addressed by modification of the management strategies, or potentially modification of management goals (Pigram and Jenkins 2006; Manning 2014; Hockett, Marion, and Leung 2017).

Cross-boundary management adds a layer of complexity to the recreation management process due to an increase in the amount of land owner directives and management goals. Complexity may increase if there are potential conflicts between goals of different land owners. All land owners have to abide by environmental and land use regulations at a variety of scales. For example, at the federal level compliance with National Environmental Policy Act, Endangered Species Act, and Clean Water Act, at the state level with State Environmental Policy Act, Growth Management Act, and at the local level with the County and City Comprehensive Plans, Shoreline Management Act. Land owners may have additional requirements based on their structure. For instance, private property owned by a logging company may be managed for maximizing profit for shareholder or property owned for mitigation purposes may be managed to maintain predetermined condition standards.

*Recreation Management Strategies*

Once management goals are established by land owners, strategies for management are selected to accomplish the goals. Recreation management goals often include limiting the impact of recreation activities on the landscape to levels that have been determined as acceptable for the landscape while providing opportunities that meet user needs for recreation experiences. Impacts to the landscape include impacts to soil, vegetation, wildlife, and water resources. Resource managers of recreation areas generally employ two general types of strategies to manage impacts to the landscape: physical design and regulatory strategies.

**Physical design strategies**

Physical design approaches include constructing trails to concentrate user impacts to designated paths (Cole 2004; Hammitt, Cole, and Monz 2015). The location of new trails or reroutes to existing trails can be planned to avoid critical cultural or ecological sites that would be negatively impacted by public access (Miller and Gershman 1998).

Trail design and construction methods can minimize negative impacts to the landscape. Low-impact techniques include keeping trail grade at or below 10%, aligning the trail with the side slope, creating drainage opportunities, and adding materials to harden the tread surface (Olive and Marion 2009; Wimpey and Marion 2010; Marion and Wimpey 2017). These methods of trail design have been shown to minimize soil and vegetation loss, wildlife disturbance, and other impacts on the ecological landscape (Olive and Marion 2009; Wimpey and Marion 2010; Gutzwiller, D'Antonio, and Monz 2017).

**Regulatory strategies**

Regulatory strategies limit impact through rules such as prohibiting specific types of use throughout a trail system or on specific trails, closing trails or trail systems during certain seasons, and/or requiring permits to use a trail system or certain areas within a system (Wimpey and Marion 2010; Leung et al. 2013). Regulatory strategies have to be effectively communicated, understood by users, and enforced (Greer, Day, and McCutcheon 2017; Hockett, Marion, and Leung 2017).

Regulations on use of a recreation area are often communicated through outreach materials including informational pamphlets, trail maps, websites, guidebooks, apps, and signage at trailheads and on trails. Materials inform users of impacts of use and provide low-impact alternatives, such as following Leave No Trace principles and avoiding trails when soils are wet (D'Antonio et al. 2012; Kidd et al. 2015).

Regulations have been enforced through a variety of methods including installing cameras, monitoring social media sites, cultivating peer enforcement from other users, and using professional or volunteer trail stewards to actively enforce regulations. Personal contact from a trail official has been found to have the highest level of effectiveness, but does require more resources (Greer, Day, and McCutcheon 2017; Hockett, Marion, and Leung 2017). The effects of management strategies to limit impacts on the landscape are studied by the field of recreation ecology.

## Recreation Ecology Research

The field of recreation ecology research emerged simultaneously with the increase in outdoor recreation participation (Monz et al. 2010; Hammitt, Cole, and Monz 2015)

Recreation ecology focuses on measuring the environmental impacts of recreation activities on the landscapes and ecosystems in which the activity occurred (Cole 2004; Monz et al. 2010).

Initially, the use-impact relationship was understood as a curvilinear model in which more frequent use resulted in greater impacts to the landscape until a plateau was reached (Hammitt, Cole, and Monz 2015). However, further research deepened the understanding of the use-impact relationship as subject to many more factors including types of user, user behaviors, use seasonality and temporality, landscape features including soil, vegetation, wildlife, and slope, and the design of features built to facilitate use including trails, viewpoints, and campsites (Monz, Pickering, and Hadwen 2013; Marion 2016). This led to an increased focus on understanding the relationship between user behavior and impacts from recreation.

## User Monitoring Research

Monitoring users has been recognized as an important component of evaluating recreation areas, given the significance that use characteristics and patterns have on the level of impact. Collecting user data to understand how users are engaging with the landscape allows land managers to choose appropriate management strategies to achieve their goals (Wolf, Hagenloh, and Croft 2012; Pickering et al. 2018). Capturing user information, through observation and reporting, allows important data about the type, frequency, behavior, and opinion of recreational trail users to be included in the management plan (Marion 2016). As the frequency and type of use effects the level of impact and which aspects of a landscape are impacted, understanding use patterns is

critical to managing to achieve certain goals (Marion and Leung 2001; Pickering et al. 2010).

Without collecting relevant user data, management plans are based on previously-collected data, assumptions, and anecdotal evidence, and they may miss changes in use that are occurring on the ground (Cope, Doxford, and Probert 2000; Curry and Ravenscroft 2001). This section explores methods of user monitoring including use pattern studies and surveys to obtain user perceptions and preferences.

### *Use pattern studies*

Visitor use studies are conducted to look at when, where, and how users move through landscape while recreating (Cope, Doxford, and Millar 1999; Loomis 2000). These patterns can be used to identify concentrations of use that may result in high impacts to the trail and surrounding land. Additionally, use patterns highlight spatial and temporal congestion and overlaps between user groups that may result in conflicts (Campelo and Nogueira Mendes 2016; Wolf, Brown, and Wohlfart 2017).

#### Use pattern methods

Use pattern information allows managers to make informed decisions that balance preserving a desired level of landscape quality with providing desired recreational opportunities (D'Antonio et al. 2016; Pickering et al. 2018). Various methodologies have to collect use pattern data including levels of use, type of use, and user behaviors.

Counter studies use mechanical or digital counting devices posted at trail access points, while visitor reporting methods have users fill out registers at trailheads or mark their route on a map (Cope, Doxford, and Millar 1999; Loomis 2000). However, counters lack the ability to capture the nuance of use, like length of visit, destination, and specific

route (Korpilo, Virtanen, and Lehvävirta 2017). Researchers have also distributed GPS units to users at trailheads to capture their routes as they recreate (D'Antonio et al. 2012, 2013; Taczanowska et al. 2014; Kidd et al. 2015).

Volunteered geographic information gathered through public participation geographic information systems (PPGIS) is emerging as a method of obtaining spatial data about visitor use tracks with modest resource inputs (Beeco and Brown 2013; Brown, Kelly, and Whitall 2013; Wolf et al. 2015). PPGIS incorporates local stakeholders into planning and monitoring efforts by soliciting geospatial information from the public or targeted groups (Wolf et al. 2015). A variety of methods are employed to facilitate the public input including distributing paper maps through the mail, workshop events, or interception during activities and having respondents mark which routes they use. These paper maps are then manually digitized and entered into a GIS database. Alternatively, interactive Internet maps are also developed for members of the public or stakeholder groups to mark a specific route or multiple routes they use and submit the maps for spatial analysis (Brown, Kelly, and Whitall 2013). Digitally accessed maps have the potential to be georeferenced and entered directly into a GIS database.

Spatial analysis of use patterns can illuminate user priorities within recreation areas and highlight areas and intensity of conflicts between different user groups who desire different experiences from the same landscape (Brown, Weber, and De Bie 2014). Integration of spatial and ecological data can also provide insight for resource managers trying to balance conservation objectives with recreation access. D'Antonio et al (2013) showed the management applications of integrated studies by comparing visitor use patterns, ecological conditions on trails and around lake destinations, and acceptable

levels of conditions as set by National Park management plans in Rocky Mountain National Park. Urban-proximate trail systems are particularly suited for integrated analysis as they tend to be smaller, multi-use areas with high frequency use (D'Antonio et al. 2016).

An important limitation to recognize with volunteered information is that the sample may be skewed by which users choose to submit spatial information. Efforts to increase sample size through broad distribution through a variety of sampling methods will result in a more robust sample size and reduce sampling bias (Czepkiewicz, Jankowski, and Mlodkowski 2017).

*User profiles and perceptions*

While use-pattern studies can provide generalized information on frequency, distribution, and temporality of trail use, user surveys capture the people behind the use. Surveys can capture user motivations, demographics, and perceptions of impacts and conflicts, all of which can inform management practices (Creswell 2014). Regional trail systems have begun incorporating periodic survey efforts into their visitor monitoring and management strategies (City of Flagstaff 2012; VanderWoude and Kellogg 2018). The content of each survey iteration is tailored to collect information on specific issues facing the trail system, as well as including repeated questions to track trends of use.

User demographics are frequently collected by surveys to identify who is using the trails (Manning 1999). Examining socioeconomic demographics of users can inform resource managers about the diversity of populations that are engaging with and benefitting from their lands. If the land manager strives to engage the whole community,

comparing demographics of users with demographics of the population can show the success of that objective (Villamagna, Mogollon, and Angermeier 2017).

In addition to collecting demographic information, surveys also include questions that focus on users perceptions and opinions of conditions (Andereck and Knopf 2007; D'Antonio et al. 2012; Goonan et al. 2012). Asking about the motivations of users helps managers understand the desired experience of the user, which may in turn inform policies or methods of regulating use that are mutually beneficial to user and manager (Sotomayor et al. 2014). User perceptions of trail conditions are another focus of questions to assess how users understand quality of the landscape (Goonan et al. 2012). Recognizing user perceptions of conditions can also lead to more effective management efforts by identifying the differences in user and land manager understanding of impacts and impact severity (Manning et al. 2004; Kidd et al. 2015).

Understanding conflicts between trail users is another dimension of the user experience of interest to managers. Perceived and experienced conflicts during trail use indicate the need for management to identify sources of conflict and implement strategies to improve user experience (Carothers, Vaske, and Donnelly 2001; Santos, Nogueira Mendes, and Vasco 2016; Wolf, Brown, and Wohlfart 2017). Studies focused on the perception and occurrence of conflicts between motorized/non-motorized and hiker/mountain biker user groups revealed spatial concentrations of conflict in areas where there is a high frequency of user overlap (Karimi and Brown 2017; Wolf, Brown, and Wohlfart 2017).

# CHAPTER III

# STUDY AREA

This study focuses on the Foothills trail system, a collection of non-motorized recreational trails bordering the western side of the city of Wenatchee, in north central Washington State. Wenatchee is the urban center for Chelan and Douglas counties with a population over 33,000 residents in 2017 (US Census Bureau 2017a). Two major US Highways, US Highway 2 and US Highway 97, pass through Wenatchee, making the city roughly two and a half hours from either Seattle or Spokane. Located at the confluence of the Columbia and Wenatchee Rivers, the city of Wenatchee is characterized by the foothills that taper down from the Eastern Cascades to the valley floodplain and Columbia River.

The Foothills trail system covers over 4,800 acres across the hills adjacent to the western edge of the city (Figure 2). Approximately 22 miles of trails provide access to local landmarks, scenic views, and desired recreation locations for users on foot, bike, or horseback. The Foothills trail system is accessible from seven trailheads and access points.

All of the trailheads, with the exception of Horse Lake, are accessible from city streets and are within three miles from central downtown Wenatchee. Horse Lake is six miles from downtown Wenatchee, including three miles on a steeply winding, gravel county road. The trail system consists of connected trails accessible from multiple trailheads as well as isolated trails accessible from only one trailhead (Figure 2).

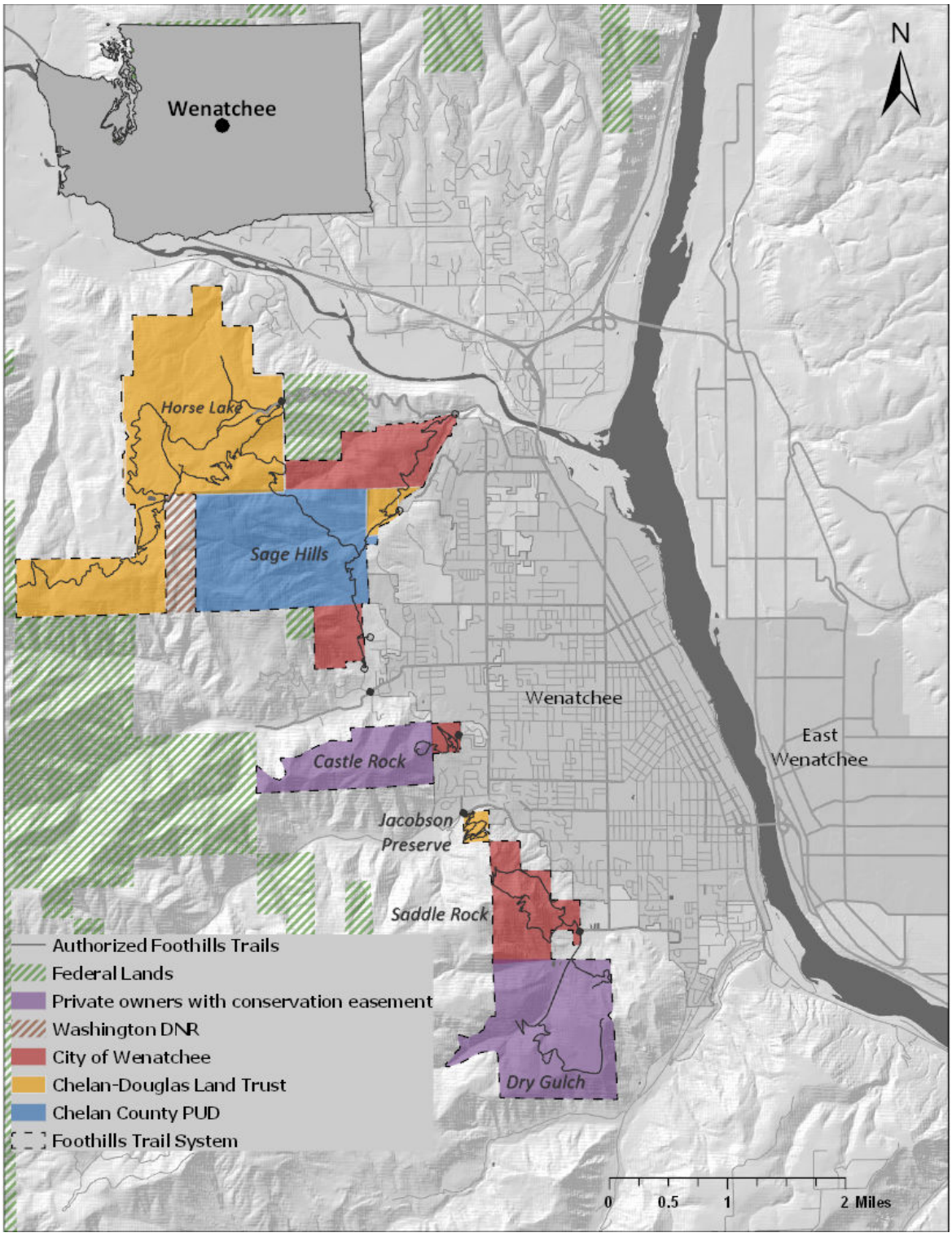


Figure 2 Foothills trails system trailheads, map by author.
Data sources: Chelan County GIS, Chelan-Douglas Land Trust, Douglas County GIS, US Census TIGER/Line.

Table 1 details the seven trailheads for the system which areas they access and the amenities present at each. This chapter will detail the biophysical and cultural elements of the trail system and its context in the surrounding area.

Table 1 Trailheads and amenities

| Trailhead | Areas accessed | Amenities |
|---|---|---|
| **Castle Rock** | Castle Rock | Signage, 7 parking spots, pit toilet, picnic shelter. |
| **Day Drive** | Sage Hills, Horse Lake | Signage, 4 parking spots |
| **Horse Lake** | Horse Lake, Sage Hills | Signage, picnic table, pit toilet, unpaved parking area |
| **Jacobson Preserve** | Jacobson Preserve, Saddle Rock | Signage, 8 parking spots |
| **Maiden Lane** | Sage Hills, Horse Lake | Signage, no designated trail parking, residential street parking available |
| **Saddle Rock** | Saddle Rock, Dry Gulch, Jacobson Preserve | Signage, large paved parking, pit toilets, picnic shelter, water fountain. |
| **Sage Hills** | Sage Hills, Horse Lake | Signage, unpaved parking area 1/3 mile away |

## Biophysical context

In order to minimize the negative impacts of recreation on the study area, it is important to understand the biophysical context of the area. This section explores the climate, geology, hydrology, vegetation, and wildlife present in the Foothills area.

### *Climate*

At the base of the Eastern Cascades, Wenatchee has a temperate climate typical of areas leeward of the mountain range. Summers are dry and warm, averaging 88-60°F, while winters are wet and cold, with temperatures in the 20-30s°F (Figure 3). Mean annual temperature is 56.7°F, while extreme temperatures of 110°F in July and -20°F in January have been recorded. Average annual snowfall is 26 inches and overall annual precipitation is nearly 9 inches, with the majority falling between November and

February (Western Regional Climate Center 2016). The dry, hot summers create conditions conducive to wildfires; recently, wildfires burned significant areas of the foothills in 2012, 2015, and 2016.

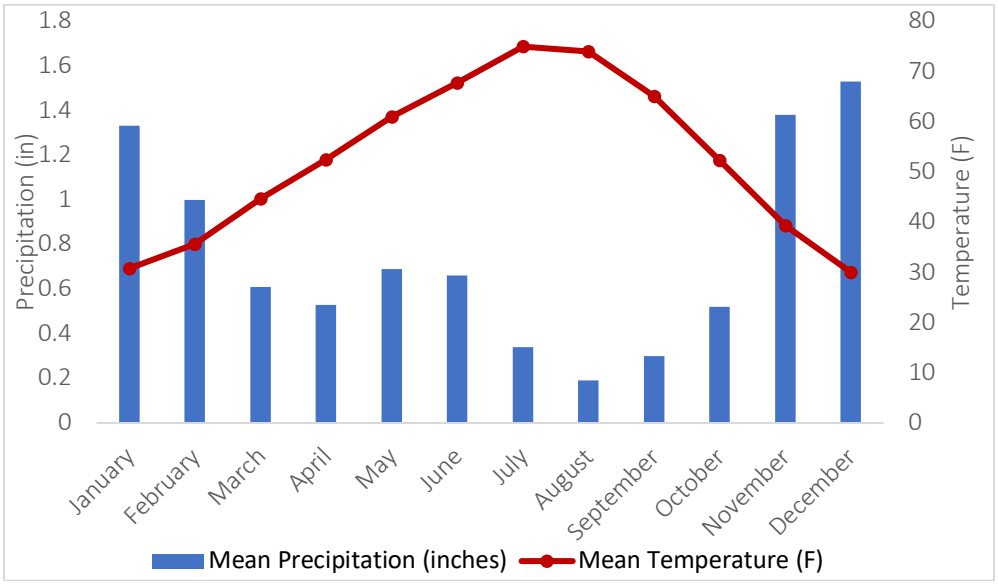

Figure 3 Average monthly temperature and rainfall for Wenatchee, WA from 1981-2010 records. Source: Western Regional Climate Center.

*Soils and Geology*

The foothills are mostly part of the Chumstick Formation, a Tertiary sedimentary formation, primarily composed of sandstone and shale (DNR 2017). The sediments are unconsolidated due to being coarse-grained and weakly-cemented. Andesite dikes and sills create several rocky outcroppings that stand out along the ridge tops of the foothills, including the local landmarks and trail user destinations of Saddle Rock (Figure 4) and Castle Rock. Loose alluvium sediments from the foothills flooded down the canyons to the river floodplain where present-day Wenatchee is located (DNR 2017).

Figure 4 View of Saddle Rock from trailhead, photo by author, 2018.

The area is characterized by high slope angles, with averages around 25° and maximum angles of 60° (DNR 2017). The aspects are primarily north and south facing, as the ridges tend to run east-west. The soils of the foothills are mainly silt loams on steep slopes; the most common soil type in the study region is Bjork silt loam, with moderately steep slopes of 45-65% (DNR 2017). The soils are moderately to highly erodible and relatively shallow, hitting bedrock around 26 inches below the surface. Silt loams are well draining with moderately high capacity to transmit water (National Cooperative Soil Survey 2002). The north end of the foothills by Horse Lake is generally composed of Yaxon and Bjork silt loams on 8-65% slopes. In the south, the Saddle Rock area has Bjork silt loams, with the majority of the trail system on slopes of 45-65% and dispersed Bjork rocky outcroppings (Natural Resources Conservation Service 2017).

Extractable mineral deposits were found in the southern area of the Foothills, near present day Saddle Rock and Dry Gulch. Deposits of gold, silver, mercury, gypsum, perlite and refractory clays and shales were documented as early as the 1930s (Hunting 1956; Mason 1997; Resources 2017).

### *Hydrology*

Water resources are sparsely dispersed in the Foothills area. An inventory of point-sources for water found 19 natural springs and nine man-made wells or troughs, which were primarily concentrated in the Horse Lake and Dry Gulch areas (The Trust for Public Land and CORE GIS 2010). The Foothills contain 297 acres that are considered riparian areas due to their proximity to seasonal or perennial streams or creeks. Drainages transport water due to seasonal snowmelt or high precipitation events, but there are no permanent watercourses. In the northern foothills, the seasonal Horse Lake (Figure 5) provides an important water source for wildlife, however the lake is usually dry by midsummer (The Trust for Public Land and CORE GIS 2010). Dry Gulch and Number One Canyon have the potential to flood during heavy rainfall events, with high erosion events possible (City of Wenatchee n.d.).

Figure 5 Horse Lake in October, photo by author, 2018.

*Vegetation*

Shrub-steppe is the primary ecosystem of the foothills with patches of east side dry conifer forest present on north-facing slopes. Shrub-steppe consists of perennial grasses, shrubs, forbs (wildflowers), and mosses and lichens that make a biotic soil crust (O'Connor and Wieda 2001). Shrub-steppe covered most of eastern Washington before land was converted for agriculture (Dobler et al. 1996). Common native shrub-steppe species present in the foothills region include big sagebrush (*Artemisia tridentata*), three-tip sagebrush (*Artemisia tripartita*), Sandberg bluegrass (*Poa secunda*), bluebunch wheatgrass (*Pseudoroegneria spicata*), arrowhead balsamroot (*Balsamorhiza sagittata*), and sulphur lupine (*Lupinus sulphureus*). Figure 6 shows spring vegetation growth following winter snow melt. The dry east side forest is characterized by drought tolerant species including ponderosa pine (*Pinus ponderosa*) and Douglas fir (*Pseudotsuga menziesii*) (Chelan-Douglas LandTrust n.d.).

Figure 6 Spring vegetation looking northwest from Horse Lake area toward the Cascades, photo by author, 2017.

The vegetation of the shrub-steppe has a mixed tolerance for fire. While the grasses are fairly resilient to fire, and are able to grow back, the shrubs are intolerant to fire and are destroyed, especially during high intensity fires (Haugo et al. 2010). In the absence of the shrubs, non-native annual grasses can move in and decrease viability for shrubs to reseed while increasing fuels for more high-intensity events in the future. As is common across shrub-steppe ecosystems in Washington, non-native annual grasses like cheat grass (*Bromus tectorum*) are spreading across the foothills landscape, in part due to the impacts of fire (Dobler et al. 1996).

Properties in the Foothills trail system are managed for wildlife habitat and ecosystem health in addition to recreation. There are active programs to encourage the success of native and wildlife forage species while limiting the spread of nonnatives (Chelan County PUD 2015; Chelan-Douglas Land Trust 2015). One species listed as sensitive by the State of Washington is found on Foothills lands, the longsepal globemallow (*Iliamna longisepala*) As a sensitive species, the longsepal globemallow is at risk of declining populations, but is not threatened or endangered by extinction (National Marine Fisheries Service 2002; Camp et al. 2007; Natural Resources Conservation Service 2018).

### *Wildlife*

The native grasses and shrubs provide important food sources for species like Rocky Mountain mule deer (*Odocoileus hemionus hemionus*). Deer in the east slopes of the Cascades eat a higher percent of shrubs in their diet than deer on the Columbia Plateau. The change in vegetation due to fires and other ecosystem disruptors can negatively affect available food sources for deer. Deer populations in the slopes of the

Cascades usually range up in to the Cascade crest during the summer, and return to foothills for the winter (Wildlife 2016). Residential development in the historic low-elevation winter mule deer range has limited winter habitat (Rasmussen 2007; The Trust for Public Land and CORE GIS 2010). As a result, winter closures to public access are in effect for the Horse Lake, Sage Hills, and Dry Gulch portions of the Foothills trail system to provide winter habitat (Chelan County PUD 2015; Chelan-Douglas Land Trust 2017a). The winter closure to the PUD Home Water Wildlife Preserve property in the Sage Hills is part of the Federal Energy Regulatory Commission requirements for the Rock Island Dam operating license, the details of the mitigation are found in the PUD section on page 30.

Shrub-steppe ecosystems like the Foothills also support many bird species, including Western meadowlark, horned lark, Brewer's sparrow, and vesper sparrow. Common mammalian species include coyote and gopher. Bird species diversity positively correlates with plant species diversity generally, but some species show a negative correlation between bird species and percent cover of non-native annual grasses (Dobler et al. 1996).

## Cultural Context

Wenatchee's location at the confluence of the Columbia and Wenatchee Rivers is a critical factor in its historical and current settlement and land use. The following sections will discuss the cultural context of the area. Historic land use, the current population, and outdoor recreation in the Wenatchee area will be explored, as will the

development of the Foothills trail system, the current landowners, and the management context of the trail system.

### *Historic Land Use*

The native Wenatchi, a Salish speaking tribe, were seminomadic, moving around the region between established camps for hunting, fishing and gathering. The area of present-day Wenatchee was ideal for winter camps and more permanent settlements for the Wenatchi due to its central location relative to key fishing and foraging areas along the Wenatchee and Columbia rivers and in the foothills of the Cascades (Scheuerman 1982).

The first Europeans in the valley were fur trappers and Catholic priests in the early 1800s, and western expansion quickly took off. By the mid-1800s, Governor Isaac Stevens was tasked with clearing the way for railroads and homestead properties by signing treaties with native tribes to cede their traditional lands. Despite the Wenatchis wishes for the creation of their own reservation to stay near to the resources they depended on, they signed onto the Treaty of 1855 as one of the Confederated Tribes of the Yakama Nation. Some tribal members moved to the Yakama reservation in south central Washington, but many stayed in their traditional area or relocated to the Colville reservation to the north (Scheuerman 1982).

The City of Wenatchee was founded in 1888 with farming, logging and mining as the main industries (Morgan 1949). The Great Northern Railroad was completed through Wenatchee in 1893 increasing its potential as a regional trade center (Dietrich 1995). Early agricultural investors took advantage of the gently sloped lands along the river to

replace the native shrub-steppe with agricultural crops, finding the area ideal for tree fruit crops.

The current-day foothills properties were held in private ownership before becoming City property or private property with access easements. The Horse Lake area in the northern Foothills was farmed as wheat fields and fruit orchards by two families until 2001 (Chelan-Douglas Land Trust n.d.). Three gold and silver mines, and more claim sites, were historically active along the Saddle Rock trail corridor (McNiel 2014). The Asamera-Cannon gold mine near the Saddle Rock trailhead and Dry Gulch area produced nearly 1.25 million ounces of gold and 2 million ounces of silver from 1985 until its closure in 1994 (O'Neil 1985). Initial mine remediation was completed in 2000, however elevated levels of heavy metals required further clean up in 2015 (McNiel 2014).

The completion of the Rock Island dam on the Columbia seven miles south of Wenatchee in 1931 was the beginning of hydropower facilities in the region (Morgan 1949). Construction on the Rocky Reach dam, seven miles north of the city, began in 1956 (PUD n.d.). The electricity generated by the dams supported the growth of Wenatchee's population and industries.

### *Current population*

Wenatchee is the largest city and county seat of Chelan County, with an estimated population of 33,544 people in 2017 (United States Census Bureau 2017a, 2017b). Across the Columbia River, in Douglas County, is the city of East Wenatchee. Together the cities form the largest urban center in North Central Washington, with over 47,000 residents (United States Census Bureau 2017a). The median age for Wenatchee is 35,

with 27.7% of the population being under 19, 7% are between 20-24 years old, 25% are between 25-44 years old, and 24.5% are 45-64 years old, and 15.8% are 65 years or older (United States Census Bureau 2017a, 2017b). The population is approximately 30% Hispanic or Latino, and 63% is White (United States Census Bureau 2017b). Currently 60% of the population over 19 is in the labor force, with the primary employing industries being education, government and health care, followed by retail, agriculture, and food and tourism services. Agriculture remains the highest economically producing industry in Chelan County due to the high density of fruit orchards. The median household income was $45,000, and 13.5% of the population lived below the poverty line in 2016 (United States Census Bureau 2017a, 2017b).

As the central city in North Central Washington, Wenatchee is a regional hub for government, healthcare, and commerce. The population of Wenatchee and the surrounding area is projected to continue to grow in the future, primarily due to migration rather than natural change or annexation (Washington State Office of Financial Management 2018). Migration rates to Chelan County are high due in part to the location being a recreation county which leads to higher in-migration rates than a non-recreation county (Headwaters Economics 2019b).

### *Outdoor Recreation*

Outdoor recreation opportunities have long attracted people to the Wenatchee area and have become a marketing point for the city to attract visitors and future residents (ECONorthwest 2017). In addition to the Columbia and Wenatchee Rivers and the Foothills trails adjacent to the city, residents can reach trailheads for hiking, backpacking, and mountaineering, rock climbing spots, lakes and rivers for fishing and boating,

mountain bike trails, and downhill and Nordic ski areas within a half-hour drive of Wenatchee. The Foothills trails provide easy and regular access to recreation opportunities and maintaining the system is an established priority for the community (The Trust for Public Land and CORE GIS 2010).

Outdoor recreation is important to the residents of the region. In a 2015 survey of CDLT members and community residents in Chelan and Douglas counties, protecting and ensuring recreational access was the highest ranked response for respondents' most important value; protecting quality habitat and protecting water quality were other high ranking choices (Solid Ground Consulting 2015). Nearly 95% of residents in communities in Chelan and Douglas counties were satisfied or very satisfied with their access to outdoor recreation opportunities (ECONorthwest 2017).

Outdoor recreation also contributes to the economy of the region. A 2017 study found that outdoor recreation contributes $640.7 million to Chelan County and $204.3 million to Douglas County (ECONorthwest 2017). Estimates of average expenditures per participant per day vary, however, expenditures are greater for biking than hiking at the regional, state, and national level (Briceno and Schundler 2015; ECONorthwest 2017; Rosenberger et al. 2017). While hiking is associated with lower expenditures, hiking occurs at higher frequencies than biking in Chelan and Douglas counties (ECONorthwest 2017). These contributions come from both residents and visitors. Wenatchee is easily accessible in under three hours from the state's large urban centers, making it a popular destination for recreation trips. In a survey conducted by ECONorthwest (2017), 87.6% of visitors to the two-county region participated in a trail-based activity, including hiking, trail running, and mountain biking.

Outdoor recreation also attracts new residents to the region. While non-recreation counties lost residents from 2010-2016, recreation counties saw positive net in-migration (Headwaters Economics 2019b). Chelan County follows the trend as a metropolitan recreation county with an in-migration rate of 28.3 people for 1,000 residents (Headwaters Economics 2019a). However, Douglas County proves an exception as a metropolitan non-recreation county with a net immigration rate of 40.1 people for every 1,000 residents (Headwaters Economics 2019a). Recreation counties have higher average household incomes than non-recreation and people moving in to recreation have higher incomes than those moving into non-recreation counties (Headwaters Economics 2019b). Chelan and Douglas counties follow these trends with the average annual household income for existing residents in Chelan County at $62,190, nearly $6,500 greater than the average annual household income for existing residents in Douglas County, $55,723 (Headwaters Economics 2019a). New residents moving to Chelan County also have higher incomes than new residents to Douglas County, with more than a $10,000 difference in average annual household incomes (Headwaters Economics 2019a).

### *Development of Foothills Trail System*

Due to their proximity to the city of Wenatchee, the Foothills have a long history of informal recreational use. Efforts were initiated in the 1940s and 1960s to establish a state or regional park at Saddle Rock. While these efforts were unsuccessful, the desire to preserve the landmark was consistent (City of Wenatchee 2007). Growing populations and increasing development throughout the settling of Wenatchee led residents to think about intentionally planning to balance developed areas with open space in the foothills in the early 2000s (City of Wenatchee 2007; The Trust for Public Land and CORE GIS

2010; Herrington 2015). Landowners donated 35 acres to Chelan-Douglas Land Trust to establish Jacobson Preserve in 2000 (Herrington 2015). The families farming at Horse Lake approached the CDLT in 2005 to purchase the Horse Lake properties and protect the land from development, restore native plants to the former agricultural fields, and provide wildlife habitat and public access (Herrington 2015).

The Wenatchee Foothills Trails Plan was developed in 2006 to create a conceptual vision for a system of recreational trails along the western foothills and seek grants to fund initial trail and trailhead construction. The City of Wenatchee, Chelan-Douglas Land Trust, and the Wenatchee Valley Trails Committee were active in the planning process and the system was designated for non-motorized uses to satisfy all land owners (City of Wenatchee 2007). The Wenatchee Valley Trails Committee existed primarily to engage stakeholders in creating the plan for a trail system and the committee dissolved after the planning process concluded (The Trust for Public Land and CORE GIS 2010). In 2017, Wenatchee Valley TREAD (Trails, Recreation, Education, Advocacy and Development), was formed as a new regional recreation body that aims to bring all recreation stakeholders together to coordinate resources and advocate for recreation throughout the Wenatchee area (Wenatchee Valley TREAD 2018).

This plan laid out the development of different trailheads as access points and envisioned a connecting trail system to allow continued travel through the foothills with access trails connecting to the city. The plan included high amenity trailheads at Saddle Rock and Castle Rock with large parking areas, educational and informational signage, bathrooms, and picnic areas, medium amenity trailheads at Horse Lake and Day Drive with parking, informational kiosks, and toilets, and low amenity trail access points from

neighborhood streets at Jacobsen Preserve, Sage Hills, and Maiden Lane that provide some informational signage. The plan also highlighted the need to buy property or establish easements to formally secure continued public access (City of Wenatchee 2007). Progress on creating the Foothills trail system envisioned in the 2006 plan began with the purchase of the Horse Lake properties (Herrington 2015).

In 2009, a series of community planning meetings were held to generate a cohesive approach to land use in the foothills, culminating in the Wenatchee Foothills Community Strategy (The Trust for Public Land and CORE GIS 2010). Coordinated by the Trust for Public Land, Chelan-Douglas Land Trust, Chelan County, and the City of Wenatchee, this strategy focused on development, wildlife and habitat, and recreational use in the foothills area. Recreation goals included following up on creating the trails detailed in the 2006 plan, and protecting access through acquiring properties with easements that allowed public access (The Trust for Public Land and CORE GIS 2010).

A fundraising and outreach campaign was developed by CDLT based on the 2009 strategy and resulted in the acquisition and development of several Foothills properties. A medium amenity trailhead opened at Horse Lake in 2010. The Saddle Rock property was purchased in 2010 by the City of Wenatchee, with a conservation easement held by CDLT, from Washington State Department of Natural Resources. Lower Castle Rock was purchased in 2013 by the City of Wenatchee to build a trailhead and trails that would connect to the privately-owned upper Castle Rock area (Herrington 2015). These property acquisitions and easements resulted in the Foothills trail system as it exists today, under a patchwork of land owners with cross-boundary management.

*Current Landowners*

The following section profiles the five current landowners of Foothills trail system properties. The entity, their land holdings, their management goals, and their documented management plans as of 2019 are detailed below.

**City of Wenatchee**

The City of Wenatchee (City) owns 865 acres of the Foothills trails, including the Saddle Rock area, the base of the Castle Rock trail, and part of the Sage Hills in the northern foothills (Figure 2). The Foothills trails fall under the City of Wenatchee Parks, Recreation and Cultural Services Department and the development of trails and trailheads is included in the department's Parks, Recreation, and Open Space Plan (City of Wenatchee Parks Recreation and Cultural Services Department 2017). The vision of the department is to provide high value programs, facilities, and services to the community of Wenatchee. Parks are classified as neighborhood parks, community parks, regional parks, special use areas, or natural open space areas and the specific goals for parks and recreation areas vary by designation.

Saddle Rock is designated a regional park with the intention of providing recreation opportunities for both residents and users from outside the area, recognizing the demand for recreation from outside visitors as well as local users. Saddle Rock is entirely on City property although it is adjacent to privately owned Dry Gulch trails, and can be connected to Jacobson Preserve, owned and managed by CDLT.

City owned portions of Castle Rock, Sage Hills, and Horse Lake trails are designated as natural areas under the Parks, Recreation and Open Space Plan. The primary goal for natural area is to conserve lands in a natural state with recreation as a

secondary use when public access is allowed (City of Wenatchee Parks Recreation and Cultural Services Department 2017). The City also holds the conditional use permit for the trail in the Sage Hills that crosses the PUD property (Chelan County PUD 2007).

The City and Chelan-Douglas Land Trust work together to manage the trails and trailheads. As of yet a formal master agreement has not been signed, but there is a mutual understanding is that the City maintains the trailheads and the Chelan-Douglas Land Trust maintains the trails. The City's Public Works Department fulfills the trailhead maintenance needs including cleaning restrooms and trash cans at Saddle Rock and Castle Rock trailheads (Beener 2018b; Beener et al. 2018).

**Chelan-Douglas Land Trust**

Chelan-Douglas Land Trust (CDLT) is a private non-profit conservation organization focused on protecting natural lands and preserving public access to local areas. CDLT owns 1,815 acres in the Foothills, including Horse Lake and Jacobson Preserve properties and a portion in the Sage Hills (Figure 2). CDLT also holds conservation easements on privately owned parcels at Castle Rock and Dry Gulch. In the past, CDLT has facilitated the donation or purchase of properties in the Foothills from private landowners to CDLT or the City (Chelan-Douglas Land Trust 2015).

Public access is determined as appropriate by property characteristics, goals, and owner wishes in the case easements on private lands (Chelan-Douglas Land Trust 2017a). While not all properties that CDLT owns or holds easements on allow for public access, those that do are managed for the goal of equal access to parks and trails for everyone (Chelan-Douglas Land Trust 2015).

Trail guidelines were developed to standardize the maintenance protocol for the Foothills trails (Chelan-Douglas Land Trust 2011). CDLT employs a trails manager and seasonal trail assistants to plan and implement trail construction and maintenance. Trail volunteers are also recruited and trained for maintenance and outreach projects.

**Chelan County Public Utility District**

The Chelan County Public Utility District (PUD) owns a 960-acre parcel in the center of the Sage Hills area in the northern Foothills which connects the Sage Hills and Horse Lake areas. The land was established as a preserve to offset the impacts of the Rock Island dam to riparian and upland wildlife habitat areas (Federal Energy Regulatory Commission 1989).

The PUD manages three hydroelectric dams on the Columbia River in Chelan County and provides electricity, water and other utilities to residents of the region. The Rock Island dam, located seven miles south of Wenatchee on the Columbia River, was completed in 1931 as the first hydropower facility in the region (Morgan 1949). The Federal Power Act requires all hydroelectric projects be licensed by the Federal Energy Regulatory Commission (FERC), and the Rock Island dam was relicensed in 1989 (Federal Energy Regulatory Commission 1989). As a major federal action, relicensing the dam requires consideration of the National Environmental Policy Act (NEPA), which calls for an environmental impact statement (EIS) when actions have significant environmental effects. The 1988 EIS conducted for the 1989 relicensing found that there was significant impact to at least 145 acres of wildlife habitat (Federal Energy Regulatory Commission 1988, 1989) and that impact had not been sufficiently mitigated thus far. Although the EIS stated that ideally riparian habitat would have been preserved, it acknowledged that the

PUD had already invested in creating recreation parks in riparian areas. The EIS found that setting aside a substantial area of upland habitat, and moving existing trails in the riparian recreation areas away from habitat sites, would sufficiently mitigate the wildlife impacts and satisfy regulations of the National Environmental Policy Act and the Council on Environmental Quality (Federal Energy Regulatory Commission 1989). The PUD already owned a 960 acre parcel in the Foothills that became the Home Water Wildlife Preserve (Home Water) to meet the upland habitat mitigation requirements (Federal Energy Regulatory Commission 1988, 1989). The license also required a wildlife management plan to be submitted that detailed mitigation and enhancement efforts to provide substitute wildlife habitat from the riparian habitat loss as well as any monitoring plans (Federal Energy Regulatory Commission 1989). A subsequent EIS in 2002 upheld the wildlife mitigation requirement for the dam (National Marine Fisheries Service 2002).

All federally issued permits, including those granted by the FERC to the PUD, are subject to Section 7a(2) of the Endangered Species Act (ESA) of 1973 which requires consultation of the US Fish and Wildlife Service when an action may affect a listed species. The wildlife mitigation required by FERC that established the Home Water Wildlife Preserve is separate from consultation and mitigation required for ESA species. At the time of the 1989 relicensing, bald eagles were the only federally listed species, and mitigations to impacts to eagles were considered separately (Federal Energy Regulatory Commission 1988). The federal listing of Upper Columbia River steelhead (*Oncorhynchus mykiss*) as threatened, and Upper Columbia River spring-run chinook salmon (*O. tshawytscha*) as endangered in March 1999 required consultation on impacts to those species for future actions regarding operation and licensing of the dam (NOAA Fisheries 2002; Maier 2019).

The wildlife management plan required by the 1989 FERC license for the Rock Island dam shifted habitat enhancement efforts from Home Water to Swakane Canyon, a nearby Washington Department of Fish and Wildlife (WDFW) property that had been damaged by a fire in 1988 (Chelan County PUD 1989). The PUD, with letters of support from WDFW and the US Fish and Wildlife Service, reasoned that the Swakane property had more potential to provide riparian habitat than the Home Water Preserve due to Home Water lacking existing water resources that could be enhanced. The FERC approved the PUD's funding of riparian enhancement efforts on the Swakane property and allowed for Home Water to have minimal active enhancement efforts, while remaining in its natural state to provide habitat for existing wildlife populations (Chelan County PUD 1989).

Despite its designation of a wildlife preserve, Home Water's location adjacent to the northwestern edge of the City of Wenatchee made it a popular location for recreational access to the foothills. As the area population increased, and efforts began to officially protect and designated public access areas in the foothills, the need for formally approved access or enforced closure of the area was necessary. Allowing public recreational access had to go through an approval process with the FERC to ensure it would not negate the wildlife habitat functions of the property. This process required the PUD consult WDFW on impacts of recreation on resident wildlife species. WDFW found that Home Water provides critical winter range for mule deer and recommended winter closure to access to the area (Chelan County PUD 1989).

In 2007, the PUD granted the City of Wenatchee a permit for conditional use, approved by FERC, which allowed the construction of one trail across Home Water to connect to other trails and the development of associated trail heads outside of the

preserve. The permit details that the PUD is not responsible for any aspect of trail construction, maintenance or improvements, all of which are the responsibility of the permittee (Chelan County PUD 2007). The City of Wenatchee is the official permittee, but Chelan-Douglas Land Trust is responsible for trail maintenance per agreements between the City and CDLT (Beener 2018a).

Although there is one official trail 2.1 miles in length crossing the Home Water property, there are also 4.7 miles of unauthorized user built trails on the property that have been identified by CDLT trails staff. Unauthorized trails are not recognized by the PUD and as such, no work to maintain them can occur without FERC approval (Beener et al. 2018). Discussions have been broached to incorporate one or more unauthorized trails into the official trail network and close the other unauthorized trails, however no action has been taken thus far due to the need for a formal consultation and approval process. However, the Rock Island dam is due for FERC relicensing in 2028 and the PUD has stated they would prefer to apply for changes to the property as an amendment to the current license before beginning the relicensing process, making the present an opportune time to address unauthorized trails (Beener et al. 2018).

**Private Trusts and Owners**

Private trusts and landowners own 1,191 acres of land in the trail system. The Dry Gulch area and the upper area of Castle Rock are privately owned (Figure 2). These private owners work in partnership with the City and CDLT to maintain the trailheads and trails and have the authority to set regulations specific to their properties. Continued public recreation access is expected, but not guaranteed on these private lands.

The primary goal for the Dry Gulch LLC, landowner of Dry Gulch, is habitat preservation, with a secondary goal of allowing recreational access. Dry Gulch, LLC is associated with the Appleatchee Riders riding group, and allowing equestrian access is especially important. For this reason, bike use is prohibited at Dry Gulch, and the trails are closed in the winter to provide mule deer habitat (Chelan-Douglas Land Trust 2017a).

The primary goal for the Beers-Peryea family, landowners of the upper Castle Rock area, was to preserve open space and scenic view shed. Their secondary goal was to allow recreation access if no negative impacts were seen on the landscape. Conditions of use can change depending on impacts. Initially, dogs were allowed on the property if they were leashed, but after the owner observed users and found a 17% compliance rate with the on-leash policy, trail policies were changed to prohibit dogs once the trails cross onto private land (Beener et al. 2018). The owners also prohibit bike use at Castle Rock (Chelan-Douglas Land Trust 2017a).

**State and Federal Lands**

Washington State Department of Natural Resources, Bureau of Land Management, and United States Forest Service Okanogan-Wenatchee National Forest also own parcels of land in the Foothills area (Figure 2). No official trails cross federal or state land, but the parcels are adjacent to the system and likely receive off trail use. These agencies have not been as actively involved in the planning process, but they are consulted when proposed changes include their properties (The Trust for Public Land and CORE GIS 2010).

### *Management Context of the Foothills Trails*

The trails are currently managed through formal and informal agreements between land owners. The Chelan-Douglas Land Trust is generally responsible for the maintenance of the trails, while the City of Wenatchee maintains the established trailheads on city property. The Foothills trails fall under the City's Parks, Recreation, and Open Space plan, as well as CDLT's general trails and public access plans, and area specific management plans (Chelan-Douglas Land Trust 2011, n.d.; City of Wenatchee Parks Recreation and Cultural Services Department 2017). Other guiding documents are the Chelan County PUD's conditional use permit for the Home Water Preserve, and easements from private landowners.

CDLT's Trail Guidelines and Standards state "how many users will be expected" and "the type of users expected in the area" among the key factors to be evaluated when deciding on trail layout and design (Chelan-Douglas Land Trust 2011). Thus far, these decisions have been made without knowing the realities of use frequency and use type. With the ongoing discussion of formalizing a management agreement between the City and CDLT, and the prospect of pursuing an amendment from FERC for the PUD Home Water property before 2028, collecting specific use characteristics for the trail system is a clear priority.

# CHAPTER IV

# METHODS

Methods for collecting and analyzing data in this study included: (a) analysis of management plans and goals, (b) the design and distribution of a user questionnaire, (c) analysis of survey results, and (d) development of recommendations for user monitoring and management of the Foothills trail system. Data collection occurred from April 6 through October 31, 2018.

## Analysis of Management Plans

An initial understanding of the various land owners of Foothills trail system properties and the general management structure was established through assessing maps of the trail system and conversations with the CDLT Trails Manager (Chelan-Douglas Land Trust 2017b; Beener 2018b). Management plans were obtained from each land owner, and management goals were then identified through document analysis. Land owner perspectives were also gathered through attending a related conference presentation and clarified through personal communication with land owners. This section details methods used for document analysis and communication with managers.

### *Document Analysis*

Planning documents were acquired and identified for each land owner through document research and personal communication. Document analysis is frequently incorporated into studies as a qualitative method to provide context for the focus of the study (Bowen 2009). For this study, each land owner's management plan and supporting

documents were analyzed to identify the primary management goal for the owner, as well as secondary goals and level of involvement in management.

As a municipality, the City of Wenatchee periodically reviews department responsibilities, priorities, and goals, and creates strategic plans for each department. Management of the City's Foothills trails properties fall under the Parks, Recreation and Open Space Plan (PROS) of the City's Parks, Recreation, and Cultural Services Department (City of Wenatchee Parks Recreation and Cultural Services Department 2017). The City also publishes a comprehensive plan that includes specific plans like the PROS, the most recent comprehensive plan was also reviewed for Foothills related policies (City of Wenatchee 2017).

The Chelan County Public Utility District (PUD) is a non-profit municipal corporation owned by its resident-consumers and operates under a license from the Federal Energy Regulatory Commission. As such, the operating license and management plans are published and accessible to the public. The Chelan-County PUD manages the Home Water Preserve through the license to operate the Rock Island Dam and a conditional use permit that allows public access (Federal Energy Regulatory Commission 1989; Chelan County PUD 2007, 2016). The wildlife management plan submitted to the FERC, and the final Environmental Impact Statement for the Rock Island Dam, were also analyzed for details on the wildlife impact mitigation requirements (Chelan County PUD 1989; National Marine Fisheries Service 2002).

Management goals and strategies of the Chelan-Douglas Land Trust were obtained through the organization's Strategic Plan, Public Access Plan, Trails Guidelines and Standards, and Horse Lake Reserve Plan (Chelan-Douglas Land Trust 2011, 2015,

2017a, n.d.). The Public Access Plan includes private land owner management goals, as CDLT holds the agreements for the conservation easements on the properties that allow public access (Chelan-Douglas Land Trust 2017a).

Past planning documents, for the Foothills region generally and trail system specifically, from 2006 and 2009 workshops were also obtained and identified from City and CDLT records. These were analyzed to understand the history of trail system development and management (City of Wenatchee 2007; Rasmussen 2007; The Trust for Public Land and CORE GIS 2010).

*Panel discussion and personal correspondence*

A panel discussion on the management of the Foothills trails with representatives from all land owners was held at the 2018 Washington State Trails Conference in Wenatchee, Washington on October 26, 2018. The panel consisted of Hanne Beener, CDLT trails program manager, Dave Erickson, City of Wenatchee Parks and Recreation director, Frank Peryea, private land owner of Castle Rock, and Von Pope, Chelan County PUD senior wildlife biologist. Stakeholder perspective was also represented by Matt Lyons, a board member of the Evergreen Mountain Biking Alliance Central Washington Chapter (Beener et al. 2018). This discussion gave more information on perspectives of management across multiple land owners, increased understanding of current issues facing the land managers, and allowed the opportunity to ask questions to all land owners in one setting. Personal communication also occurred with the CDLT trails manager and the PUD wildlife manager to clarify language in their respective management plans.

## Survey Design

This study included a user survey to gather information about use demographics, use behaviors, and opinions regarding trail conditions and conflicts. User surveys are commonly used to gather information about users and user perceptions and opinions (Beeco, Hallo, and Brownlee 2014; Manning 2014; D'Antonio et al. 2016). This section details the survey format, sampling procedures, questionnaire design, and respondent participation.

### *Survey Format*

A questionnaire form was created with Qualtrics software hosted through a CWU subscription. An online platform was preferred for the ease of data collection and automated data entry reducing errors. This platform was chosen for its security and approval as a data gathering tool by the CWU Human Subjects Review Council.

Qualtrics requires internet connection to access the questionnaire form and store the data. A Verizon Jetpack wireless hotspot device and iPad tablets were used to access the questionnaire when doing intercept surveys at the trailheads. The questionnaire was administered on iPad tablets using the Safari application to access the Qualtrics website. The questionnaire was also available on personal smartphones, tablets, and computers through an online link. Distribution methods are discussed below.

In an effort to maintain inclusivity, a professional freelance translator translated the questionnaire form and the terms on the acceptance page into Spanish. According to 2017 census estimates, approximately 30% of the Wenatchee/East Wenatchee population is Hispanic (United States Census Bureau 2017b). The default presentation was in

English, but respondents could choose to switch into the Spanish version on the first page.

### *Human Subjects Approval*

In order to have the survey approved before the spring season of trail use began, Human Subjects Review Council exemption requirements were kept in mind during the design process to ensure it qualified for expedited approval. No identifying information was captured, questionnaires were accessed through an anonymous link and no IP addresses were recorded. Responses to the one follow-up question that asked for optional email address entry were isolated from the rest of the responses and stored separately. The Central Washington University Human Subjects Review Council approved exemption status for the study, granting it study number H18085. All requirements were met to maintain exemption status throughout the study and a termination report was filed in March 2019.

### *Sampling Procedures*

The target population of the survey was all Foothills trails users. A mixed-method, non-probability sample was collected from trailhead interception, distribution at events, and online distributions in order to collect responses. This sampling design was used to due to the expected high variability in trail use and the desire to capture as much of the target population as possible through mixed-method sampling that increased sample size (McLain et al. 2013; Creswell 2014; McGrew, Jr., Lembo, Jr., and Monroe 2014; Peterson, Brownlee, and Marion 2018). The survey was conducted from April-October to capture the period where all trails are open for use and usage is the highest. Trailhead, event, and online sampling methods are discussed in this section.

**Trailhead interception sampling**

Forty trailhead sampling sessions occurred over 35 days between April and October 2018. Sampling locations were stratified to include five of the more established trailheads that access different areas of the Foothills trail system: Saddle Rock, Jacobson Preserve, Castle Rock, Sage Hills (at the Fifth St/Number One Canyon parking area), and Horse Lake (Figure 7). These trailheads were chosen because of their accessibility, having an area that was feasible to set up an interception station, and to represent different areas accessed by the trail system. The Sage Hills, Jacobson Preserve, and Castle Rock trailheads all require users to begin on the same trail, the Saddle Rock trailhead gives access to both Saddle Rock and Dry Gulch trails, and the Horse Lake trailhead offers access to the Homestead and Road trails, from which different loops can be accessed.

Trailhead sampling sessions were stratified to sample users on weekends and weekdays in both morning (6am - 12pm) and afternoon/evening (12 pm – 6pm) time periods. Sampling periods were changed to only morning visits in August through mid-September due to high heat leading to infrequent trail use in the evening sampling window. Severe wildfire smoke from the Cougar Creek Fire resulted in unhealthy air quality in August which canceled some of the scheduled summer sampling periods. These missed sampling periods do not impact the overall survey results, given that fires are a regular part of the climate in the region, and affect use on an annual basis. Additionally, the surveys were available online (as described below in online questionnaire distribution) throughout the sampling period from April through October, including during the fire to reach more trail users.

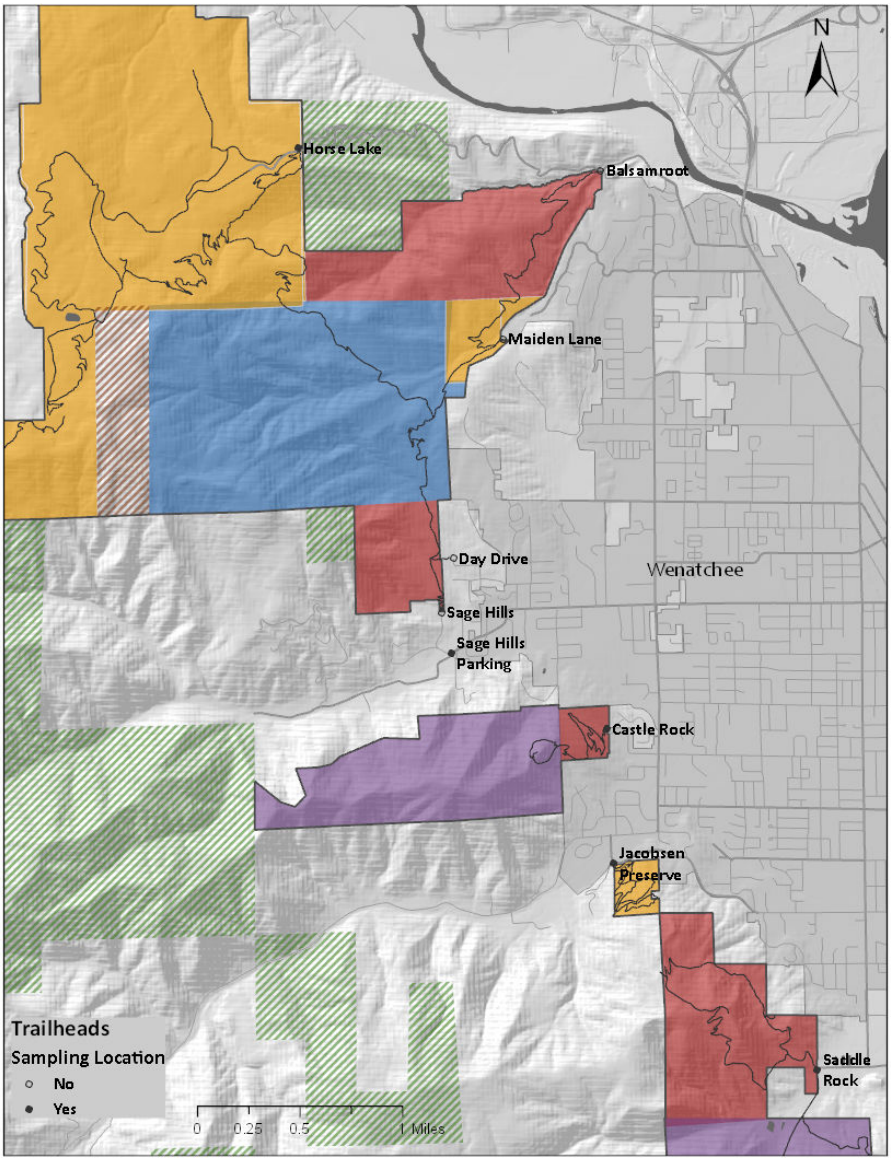


Figure 7 Sampling locations, map by author
Data sources: Chelan County GIS, Chelan-Douglas Land Trust, Douglas County GIS, US Census TIGER/Line.

All users exiting the trail system at the trailhead during a sampling period were asked if they would be willing to participate in the study (Figure 8). Users were introduced to the questionnaire through a short dialogue that explained the purpose, asked if they were over 18, and willing to participate in the survey. If they accepted, they were given the iPad and began self-administering the questionnaire. Acceptance of terms of the

study and all questionnaire instructions were given on the first two pages respondents saw.

Figure 8 Trailhead distribution station at Saddle Rock and recruitment sign.

**Event Questionnaire Distribution**

In addition to the stratified, non-probability sampling at trailheads, surveys were administered during two Run Wenatchee events and two hiking events organized by Columbia Valley Community Health at Foothills trailheads. These events were included in the sampling protocol to increase the sample size and access a larger population of users at one time. Potential questionnaire respondents were approached in the same manner as the trailhead sample.

**Online Questionnaire Distribution**

The questionnaire was also distributed online from April through October. The online distribution was included to increase sample size and robustness of sample. This

link to the Qualtrics questionnaire form was posted on the trail information page for the Chelan-Douglas Land Trust website and was sent out through newsletters and social media sites of local running and biking recreation groups, including: Evergreen Mountain Biking (Central Washington chapter), Wenatchee Outdoors, Team Naturaleza, and Run Wenatchee to their members and social media audiences.

If a viewer used the link to access the survey, they were taken to the questionnaire form on the Qualtrics website. The format and order of the questions was the same for all sample distribution methods.

### *Sampling Limitations*

While efforts were undertaken to capture the range of Foothills trail users by utilizing multiple sampling methods, the sample may have missed some user populations. These include users under 18, who were not allowed to participate, and users that declined to participate. The timing of the survey was designed to collect during spring and summer which has been anecdotally reported as the busiest season and is when all the trails are open. This design underrepresents winter-only trail users.

### *Questionnaire Design*

The self-administered online questionnaire was the primary tool to collect user information for Foothills trail users (Appendix A). Respondents answered up to 32 questions on an electronic survey form, questions were formatted as open responses, multiple-choice responses, and Likert scale matrix responses.

The questionnaire was developed with consideration to content, format, required Human Subjects Review Council approval, and as a pilot study. The questionnaire was created with input from the Chelan-Douglas Land Trust trails program manager and an

intern with Wenatchee Valley TREAD (Trails, Recreation, Education, Advocacy, and Development). The questionnaire was designed to capture demographic data, motivations for trail use, and user perceptions on trail conditions and conflicts. Input from trail managers was sought to ensure relevant issues and concerns, for example, CDLT managers concerns about off-leash dogs on trails led to questions about presence of dogs and leash use being included.

The questionnaire consisted of four parts: (1) overall trail system use, (2) specific trail visit use characteristics and perceptions, (3) spatial pattern of trail use, and (4) user demographic questions. A minimum of 27 and a maximum of 32 questions were displayed to respondents, as some follow up questions were not displayed if a previous answer made them irrelevant to the participant.

**Trail system use**

The first section of questions were aimed to gather aspects of respondents' trail system use. The section regarded overall trail use and consisted of thirteen questions to identify user activities, frequency, and motivations. The initial questions determined frequency of use by asking respondents if they had used any of the Foothills trails before taking the survey. If they had, questions about how often they used the trails and how many years they had visited the trail system were displayed.

These were followed by questions about what activities respondents participate in and their motivations for using the trails. Respondents were asked to select all activities they participate in while on the Foothills trails from the four most common uses (hiking, biking, horseback riding, and running). Multiple activities could be selected and an "Other" response option gave space for respondents to write in activities that were not

listed. The following question asked users to select up to three motivations for using the trails from a list of nine motivations. Respondents were then asked if they brought dogs while they recreated, and if so, how many dogs and whether they were on or off leash.

The subsequent two questions were included to gather a general sense of how the Foothills trails fit into the respondent's recreation activities overall. The first asked if users considered the Foothills trails their primary recreation location. The wording was intentionally unspecific to elicit answers based on user opinion and not a given standard. The next question asked users if they own any passes for using state or federal lands in the area to obtain information regarding other areas visited by users of Foothills trails. To understand how users view trail management, the following question asked respondents to enter an open response answer of who they would contact with a question or comment about the trails. Finally, two questions were included about recreation tracking, to gauge data availability and interest in participation in a use pattern study using GPS tracks.

**Specific visit route and perceptions**

The second section of questions asked respondents to answer questions about a specific visit to the trails to obtain a spatial component for trail use and trip characteristics. Users were asked what activity they participated in during the visit, how many people were in their group, and how long they were on the trails in multiple choice response questions.

Two base maps were provided for respondents to mark their paths, one for the northern and one for the southern Foothills trails. Users were asked to mark the route of their recreation by clicking and dragging dots to each trail segment they traveled.

Established trails were marked on the map, but respondents could place the dots anywhere on the map to include off-trail travel.

A matrix format was used for questions designed to gather user opinions about trail conditions. The first matrix contained different trail condition variables including the physical attributes of trail width, steepness, and vegetation, and the management variables of amount and information on signage. Respondents were asked to rank their satisfaction with each attribute on a five-point Likert scale from excellent to terrible, with the additional option of "Did not notice." The second matrix followed the same format and had respondents rank impacts of other users including presence of trash, dog and horse poop, and bicycle and horse tracks on another five-point scale from too much to none, with the additional "Did not notice" option. The "Did not notice" option was included to provide a response option indicating a lack of awareness of the condition. The "None" option was intended for users that actively assessed the presence of the condition but found none. Users were also asked about trailhead amenities including trash, bathroom, and signage. These amenities were rated either adequate or inadequate, and a "Did not notice" option was included.

To gather use of unauthorized trails and awareness of which trails were unauthorized users were asked what type of trails they were on. A multiple-choice question with only one selection allowed asked users if they had traveled on authorized, unauthorized, or both types of trails, or whether they did not know.

The following two questions were included to gather information on potential issues between users on the trail system. Respondents were asked if they experienced conflicts with other users on the trails during their visit, and a text box was provided for

respondents to give a short explanation of "yes" answers. This question was phrased to ask about direct interpersonal conflicts, such as hikers not yielding to horseback rider. It could be interpreted, but does not explicitly, ask about indirect conflicts such as social values conflict where differing values users place on the trail system and their recreation experience may clash. The second question asked if the user had encountered dogs off leash on the trails as requested by CDLT to know if off-leash dogs on trails are a problem for trail users.

**Demographics**

The final section of the survey consisted of six demographic questions including area of residence and zip code, gender, age, ethnicity, and household income. All of these were presented as questions with multiple-choice options except for zip code which respondents were asked to type in. Respondents were asked to type their country of residence instead of zip code if they were traveling internationally. These questions were used to compare trail users to the census demographics of the region and create demographic profiles of users.

The concluding question was an optional open-ended text box for additional comments. Respondents could write anything they wanted to share in the text box.

**Questionnaire Limitations**

Some questions may have been interpreted by respondents as have a "right" and a "wrong" answer, for instance having dogs on or off leash, or being on authorized or unauthorized trails. While no questions were intended to elicit certain answers, social desirability bias can affect how participants respond (Krumpal 2013).

Additionally, some questions asked respondents to report how often they visit the trails per year and how long they have been using the trails. These responses required respondents to recall information and may be exaggerated intentionally or unintentionally due to bias and recall difficulty (Converse and Presser 1986; Creswell 2014).

The phrasing of some questions and answer options allowed for multiple interpretations of a suggested response. For instance, the trail condition questions had a "did not notice" answer option which could be interpreted as the condition not being a problem, or the condition not being observed by the user. This problem may be increased for respondents who took the survey online and did not have the opportunity to seek clarification from the survey administrator.

## Questionnaire Data Entry and Analysis

This section discusses data entry and analysis methods for questionnaire responses. Data analysis was broken into two sections: spatial pattern analysis and survey questionnaire analysis.

### *Data entry*

Survey responses were saved and stored to a secure Qualtrics website. The responses from trailheads and online samples were stored separately. Responses were then downloaded as .csv files for analysis using Microsoft Excel and R and stored on a secured external drive. PDF files of individual surveys were downloaded to identify the route identified in the spatial pattern question. Entries where the participant declined the terms of the study were deleted, as were entries with no responses to any question.

### *Questionnaire analysis*

Most questions were closed questions that required respondents to choose from a set of provided options. These values were analyzed with basic descriptive statistics to determine the frequency of responses. The descriptive analysis resulted in demographic profiles and respondent characteristics. Cross-tabulation was conducted to identify differences in responses by user activity or by trailhead. Microsoft Excel and R were used to conduct the data analysis.

Questions that allowed for open-ended responses, such as the number of users or zip code, these were coded and analyzed for response frequency as well. Open-ended responses were also solicited if the respondent selected "other" to a question, and these were analyzed individually.

Inferential statistics were not included in the questionnaire result analysis because no results from the questionnaire required inferential analysis to answer the research questions and thus inferential statistics were beyond the scope of this study.

### *Spatial Pattern Analysis*

The spatial pattern analysis was used to analyze user responses to the route mapping question. The routes indicated by each respondent were manually transferred into ArcGIS Pro 2.2 in the CWU GIS lab. Base maps of all authorized and known unauthorized trails were created with each trail segment between trail junctions represented by a unique line feature. Survey respondents placed a dot on each segment they traveled on. Each survey response was manually digitized by looking at the submitted map and selecting the corresponding segments on the GIS base map. Off-trail travel was entered as closely as possible to the marked locations on the user-submitted

map by creating new line features. Direction of travel was not recorded. Each survey was saved as an individual route represented by a line feature.

Respondents' routes were coded by unique identification numbers that corresponded to survey coding completed during questionnaire data cleaning and preparation for analysis. The individual routes were merged into one shapefile. The survey responses were then spatially joined to the routes to allow for analysis of route preference by respondent characteristics. The routes were split into segments at trail junctions to allow analysis at the segment level. The join count was used to determine frequency of overall use and use by activity type. The trail segments were symbolized by a graduated color scheme according to frequency ranges of join counts.

Results from the analysis of question responses and spatial component are presented in the following chapter.

# CHAPTER V

# RESULTS

The results and discussion are presented in the following four sections: a) land ownership and management goals, b) survey results on user characteristics and perceptions, and c) spatial analysis of use patterns.

## Land ownership and management goals

The primary landowners of the Foothills trail system are the City of Wenatchee, the Chelan-Douglas Land Trust, Chelan County Public, Utility District, and private landowners. The involvement of each organization is detailed in this section and Table 2 summarizes landowner management goals.

Determining management goals of the various land owners of Foothills trail system properties revealed that goals are largely aligned in that they all acknowledge recreation as an intentional goal for the landscape. However, there are discrepancies in the priority of recreation between properties. Recreation or public access is a primary management goal for Chelan-Douglas Land Trust and City of Wenatchee properties, while recreation is a secondary goal for the PUD properties and private land owners.

### *Cross Boundary Management*

The challenges due to differing goals come in part from land owner directives. The PUD has to fulfill the requirements of their FERC license to operate the Rock Island hydropower project. CDLT has to uphold their agreements with private land owners over terms of use written in the conservation easements. The City is charged with acting for

the best interest of residents while abiding state law when creating their comprehensive plans. Private landowners have more independence in their decisions as seen by the use restrictions they place on their properties.

Table 2 Summary of management goals

| | **Primary Goal** | **Secondary Goal** | **Level of trail management** | **Management directives and plans** |
|---|---|---|---|---|
| ***City of Wenatchee (City)*** | Provide parks and recreation facilities and services to meet the needs of residents | Ensure that use of facilities is consistent with natural systems | Actively maintains trailheads, active in trail planning | Parks, Recreation, Arts, and Open Space Plan, conditional use permit |
| ***Chelan-Douglas Land Trust (CDLT)*** | Engage communities in conserving, caring for, and accessing natural lands and waters | Balance recreation and conservation: create sustainable routes that prevent habitat fragmentation | Actively maintains trails, takes lead in trail planning | Strategic Plan, Public Access Plan, Trail Plans, conservation easements, conditional use permit |
| ***Chelan County Public Utility District (PUD)*** | Provide wildlife habitat to fulfill FERC mitigation requirements for license to operate hydropower project | Allow recreational trail use if no adverse effects to wildlife | Does not actively maintain per use permit, limited trail planning due to required FERC approval | Federal Energy Regulatory Commission license, Rock Island EIS, conditional use permit |
| ***Private Owners*** | Protect open space, view, and habitat | Provide recreation access with stipulations | Varies by owner | Conservation easements and access agreements |
| ***State and Federal Lands adjacent to system*** | Manage state and federal lands for health and productivity to meet needs of present and future generations | Provide recreation to meet needs of citizens without impacting longevity of resource | Consulted if action has potential to impact state/federal land | Forest management plans |

These differing directives and subsequent differing goals for land owners can complicate efforts to coordinate goals across property boundaries. The lack of an overall

trail system management plan between all land owners is apparent from the existing management documentation and includes both formal and informal agreements. Formal agreements between land owners exist, such as the PUD granting a conditional use permit to the City for the trail in the Home Water property and conservation easements between CDLT and private land owners. There are also informal agreements like the understanding between the City and CDLT that the City will maintain trailheads and CDLT will maintain trails, including the trail on PUD property.

Despite differing goals, land owners have shown the ability and motivation to work collaboratively. For instance, when the PUD closes access to its property from December through March to provide winter habitat for mule deer per habitat mitigation requirements, CDLT and the City close access to their properties adjacent to the PUD property for consistency (The Trust for Public Land and CORE GIS 2010; Chelan-Douglas Land Trust 2017a).

The PUD has stated a desire to address the unauthorized trails on the Home Water property before entering the relicensing process for 2028 (Beener et al. 2018). This could include authorizing additional trails and/or planning for rehabilitation of existing unauthorized trails. This process would include other land owners and is an example for the need for cross-boundary management plan.

### *Management Strategies Used within the Foothills Trail System*

The Foothills trail system uses a combination of management strategies to achieve the goals of the various properties. Physical strategies include limiting the number of authorized trails through wildlife habitat areas in the Sage Hills, creating separate hiking and biking trails at Jacobson Preserve, fencing off unauthorized areas, and building trails

to reach desired rock formations and viewpoints to ensure user impact is concentrated on the trail.

Regulatory strategies include prohibiting motorized use throughout the system and requiring dogs to be on leash throughout the system (The Trust for Public Land and CORE GIS 2010). Regulations of the system include closing the Sage Hills, Horse Lake, and Dry Gulch areas from December through March (Chelan-Douglas Land Trust 2017a). Use is only allowed on authorized trails; user built or decommissioned trails are closed to allow for vegetation rehabilitation. Per landowner determination, use regulations state that bicycle use is not allowed at Dry Gulch and dogs, horses, and bicycles are not allowed at Castle Rock trails (Chelan-Douglas Land Trust 2017a). Table 3 summarizes the regulations for each area.

Table 3 Regulations for the Foothills trail areas

| Areas | Landowner | Trailheads accessed from | Additional Regulations |
|---|---|---|---|
| **Castle Rock** | City and private | Castle Rock | No horses or bikes, no dogs on private land |
| **Dry Gulch** | Private | Saddle Rock | No bikes, closed December 1- March 30 |
| **Horse Lake** | CDLT | Horse Lake<br>Sage Hills | Closed December 1 – March 30 |
| **Jacobson Preserve** | CDLT | Jacobson Preserve<br>Saddle Rock | None |
| **Saddle Rock** | City | Saddle Rock<br>Jacobson Preserve | None |
| **Sage Hills** | City and PUD | Sage Hills<br>Day Drive<br>Maiden Lane | Closed December 1 – March 30 |

These regulations are communicated through trailhead signage (Figure 9), on-trail signage (Figure 10), print and online trail guidebooks, outreach in local media and social media platforms. Although regulations are in effect, enforcement is primarily passive. The motorized use ban is achieved through physical barriers at trailheads. Enforcement of

other regulations is self-imposed, with the potential consequence of access being revoked if rules are consistently violated. Users educate each other and volunteer trail ambassadors irregularly patrol the trails to inform users of regulations, but trail ambassadors have no ability to penalize users (Beener 2018a). City properties are under the jurisdiction of the Wenatchee City Code, which include following posted trail regulations, and are enforceable by city police. Trailheads that fall within city boundaries may be patrolled by city police, but trails are not patrolled (City of Wenatchee 2019).

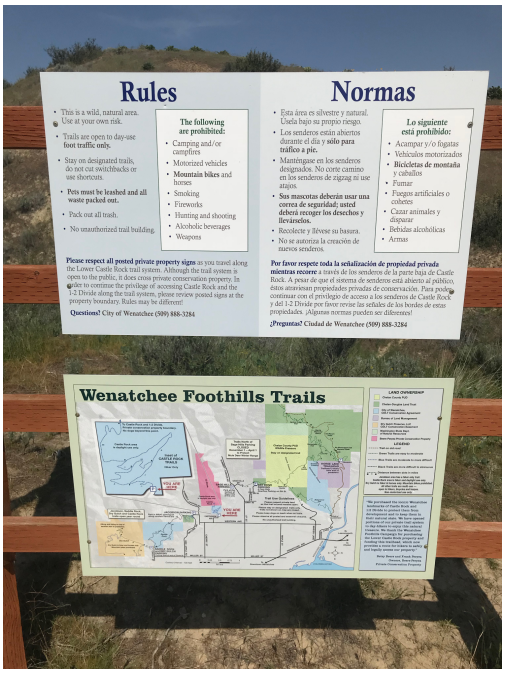


Figure 9 Signage communicating rules for use at Castle Rock Trailhead, photo by author, 2018.

Figure 10 Examples of trail closure for rehabilitation (left) and directional (right) signage, photos by author, 2018.

## Survey Results

A total of 361 responses were collected in the Qualtrics response database. The responses were reviewed for completeness and 345 surveys were useable for data analysis. The 16 survey responses that were discarded included responses where the terms of the survey had not been accepted and where no questions had been filled out. These were most likely questionnaires where the link was opened but not completed. 165 of the useable responses were completed at trailheads, 133 were completed online, and 47 questionnaires were completed at events. The events included two Run Wenatchee weekly runs on June 28 (20 responses) and October 25 (8 responses) and two hiking events organized by Columbia Valley Community Health on July 21 (7 responses) and October 20 (12 responses).

All valid responses were analyzed for each question. As respondents could choose to skip any question they did not wish to answer, results for each question are reported with the sample size for each question, n. Summary tables of all responses are presented in Appendix B.

*Representativeness of sample*

The representativeness of the combined trailhead and online results cannot be statistically determined due to the mixed-method stratified trailhead sample and the purposive online sample. However, the large sample size (n=345), is beyond the recommended size for a population of 100,000 with a 7% sampling error, 95% confidence interval and degree of variability = 0.5 (Eckblad 1991; Israel 2003) and results from the 2018 questionnaire can generally be accepted as representative of all Foothills trail users since the annual population of unique trail users is under 100,000 given the population of the Wenatchee and East Wenatchee area and estimates of visiting users.

*User demographics*

The following sections report questionnaire results from demographics questions to provide a profile of users including gender, age, ethnicity, income, and area of residence.

**Gender**

Responses were almost evenly split between males, 52%, and females, 48% (n=322). The answer choices for the question provided options for nonbinary or self-described gender identities, but no respondents selected those options. Less than one percent of respondents preferred not to answer the question.

**Age**

Age was well distributed among respondents (Figure 11), with 29% of respondents between the ages of 26 and 35, while 23% of respondents were between 36 and 45. Users aged 46-55 and 56-65 were 16% and 12% of respondents, respectively. 9% were 66 or older (n=318). Users of the Foothills trails are younger than combined census estimates for Wenatchee and East Wenatchee (United States Census Bureau 2017b).

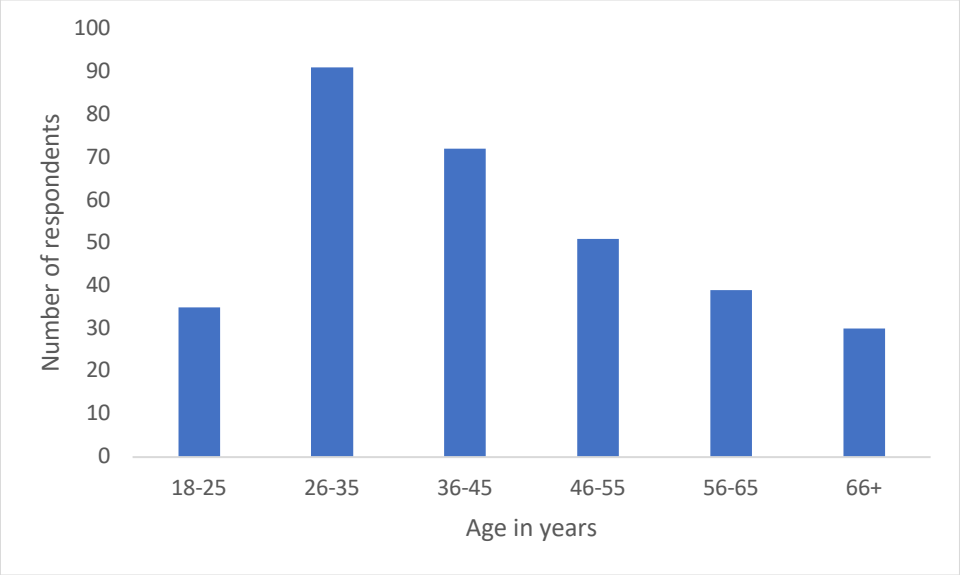


Figure 11 Age of respondents.

**Ethnicity**

Questionnaire respondents could choose more than one option for their ethnic identity. 75% of respondents reported Caucasian as an ethnic identity, and 16% identified as Latino or Hispanic (n=319). A small percent of users identified as Native American, 1%, or Asian/Pacific Islander, 2%. Less than one percent of respondents identified as African-American (Figure 12). Caucasians were reported at a higher level when compared to Wenatchee and East Wenatchee census estimates (United States Census Bureau 2017b). Although the questionnaire was translated into Spanish, it is possible that

Latino trail users are underrepresented due to a lack of bilingual/bicultural questionnaire administrator or on the CDLT website hosting the survey.

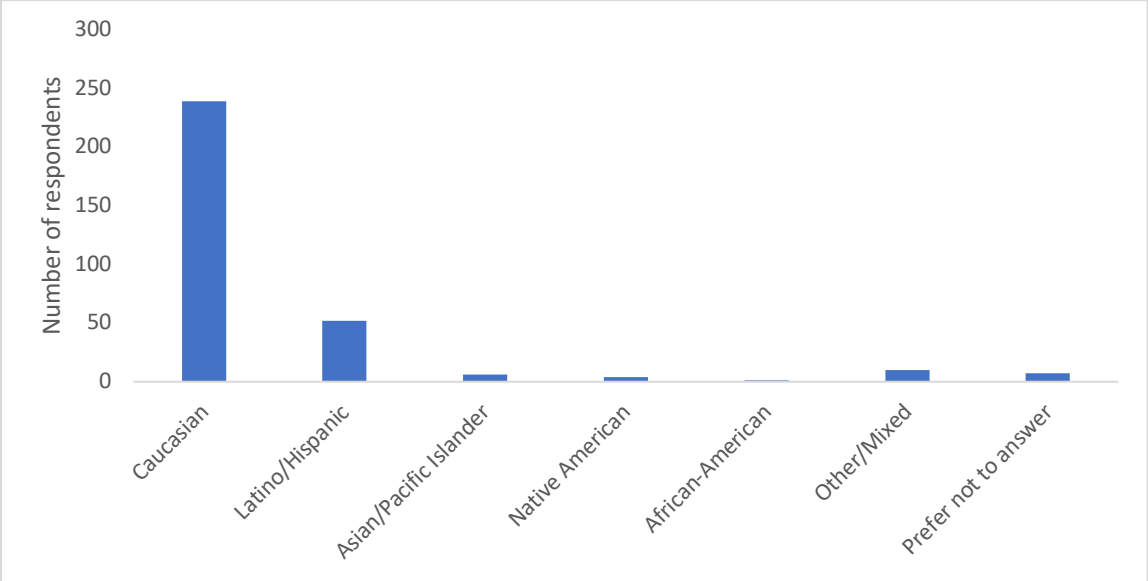


Figure 12 Ethnicity of respondents, respondents could choose multiple answer options.

**Income**

Questionnaire respondents were asked about the total household income range. 30% of respondents reported a household income of over $100,000 (n=290). Income ranges between $25,000-50,000 for 22% of users and $50,001-75,000 for 20% of users (Figure 13). Questionnaire respondents had higher incomes when compared to combined Wenatchee and East Wenatchee census, which estimate a median household income of $50,251 (United States Census Bureau 2017b).

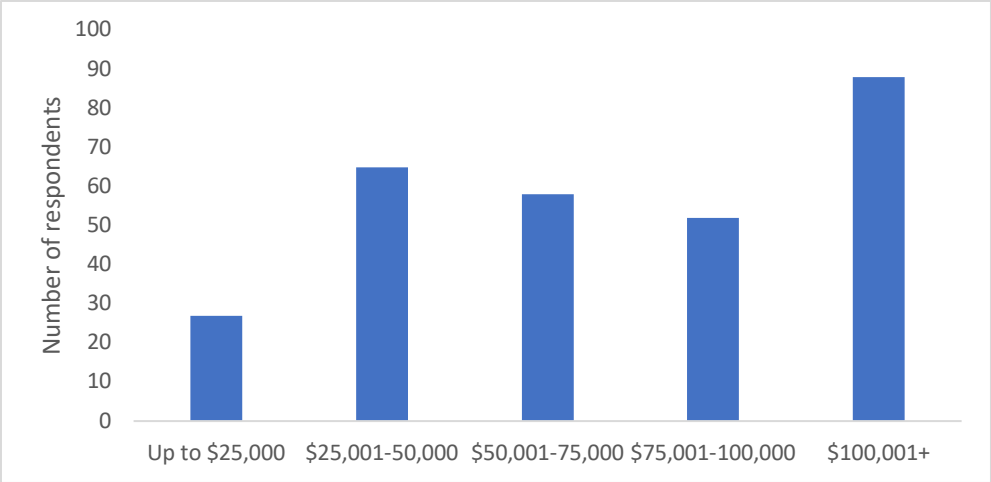

Figure 13 Annual household income of respondents

**Residency**

92% of respondents identified as primary or temporary residents of the Wenatchee Valley, and users were 8% of respondents (n=322). Respondents were also asked to list their zip code. Most users were from Wenatchee or East Wenatchee, with 58% of users listing a Wenatchee zip code and 22% of users listing an East Wenatchee zip code (n=295). Washington State residents were 95% of respondents. 65% of respondents were from Chelan County, with 22% from Douglas County. Other communities in Western Washington were represented with 6% of responses, and 2% were from other Eastern Washington communities. Trail users from out of state made up 4% of respondents, primarily from other Pacific Northwest states and Canada.

**Demographic summary**

Users were nearly equally likely to be male or female, and 68% fell between 26 to 55 years old. The majority of users, 75%, identified as Caucasian, while 16% identified as Latino. Users were overwhelmingly residents of the local area. Total annual household income was $75,001 or higher for 48% of users.

*Use characteristics*

The following sections will provide results from questions regarding respondents' use characteristics of the Foothills trails including frequency, activities engaged in, motivation, and whether or not they bring dogs.

**Use frequency and years using**

Respondents were asked about their previous use of the trail system and how often they visited the Foothills trails (Figure 14). 92% of respondents reported using the trails at least one time before their current visit (n=343). Respondents reported frequent usage, with 55% reporting that they recreate at least weekly on Foothills trails. Another 22% reported recreating at least monthly. 23% reported visiting 10 or fewer times per year (n=317).

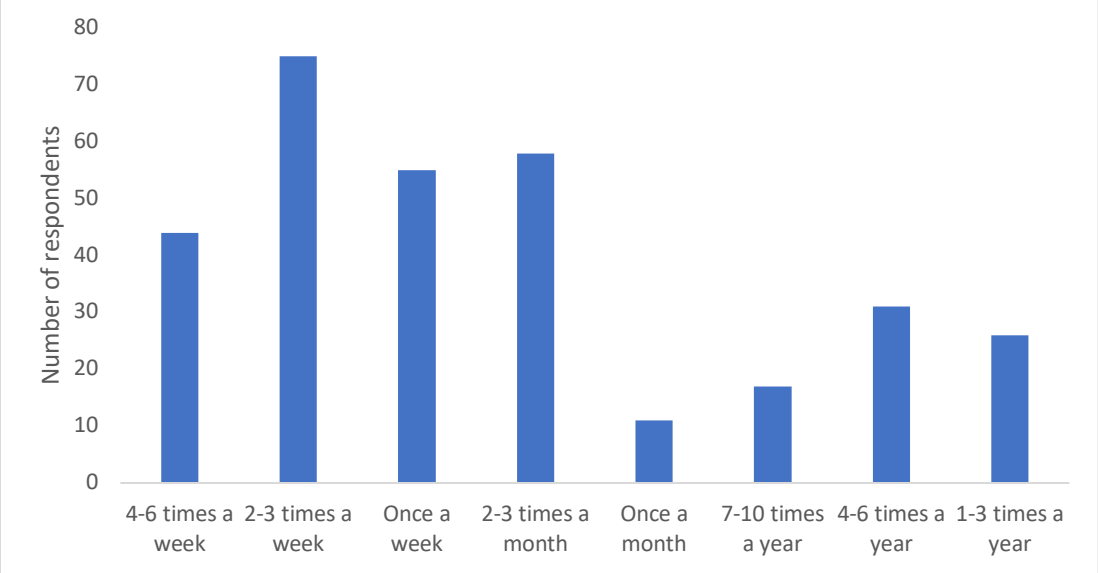


Figure 14 How often respondents visited a Foothills trail.

Respondents reported a range of length they had been using the trails (Figure 15). The results show a substantial population of longtime users, with 34% of respondents using the trail system for 9 or more years (n=300). An increasing number of users appear

to have begun using the trails in recent years, with 26% using the trails for 1-2 years, and 19% using the trails for 3-4 years. 14% of users have recreated on the trails for 5-6 years and 7% of users have recreated for 7-8 years.

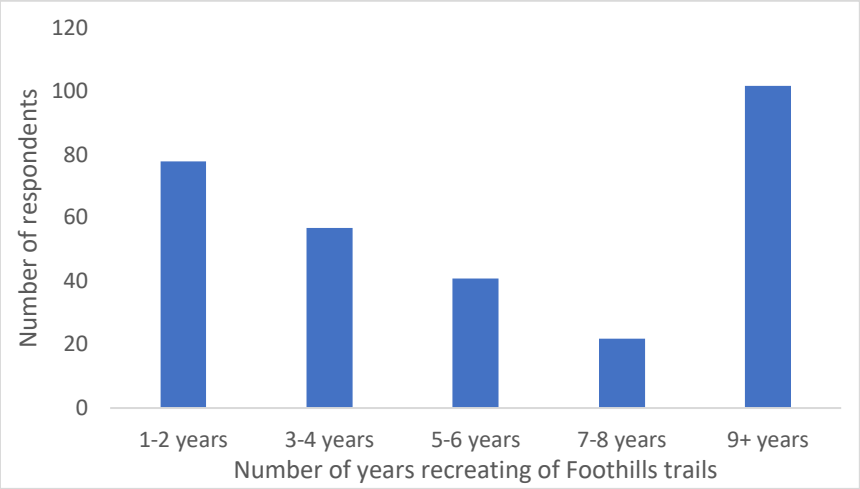


Figure 15 Number of years respondent has recreated on Foothills trails.

Cross tabulation of length of trail system use by the specific visit activity echo the overall pattern: a substantial population of longtime users as well as a large population of recent users across all activities (Figure 16). Horseback riding was excluded due to low response rate.

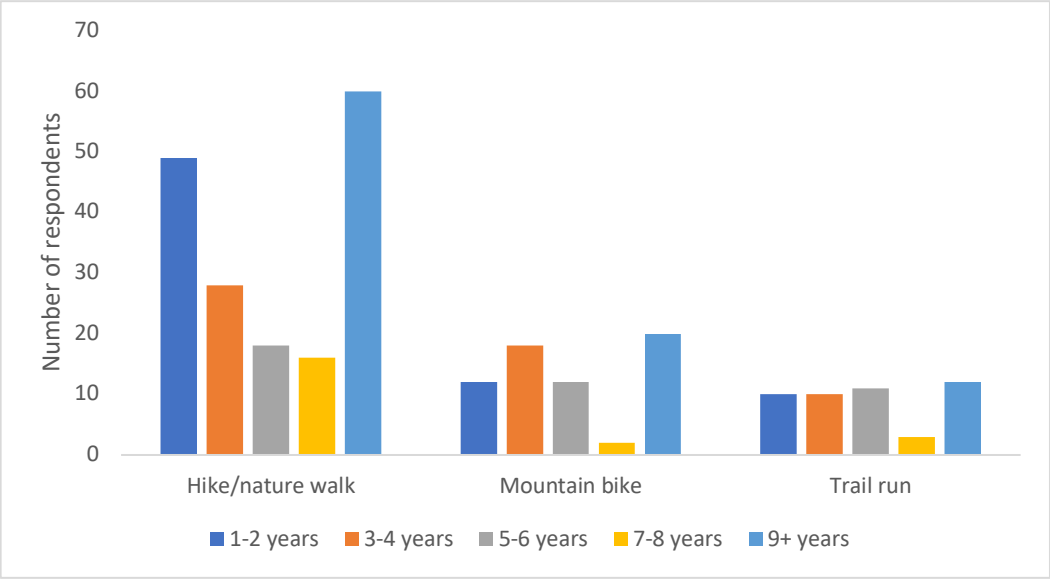


Figure 16 Length of time using the Foothills trails by activity.

**Recreation usage**

Respondents were asked if the Foothills trails were their primary recreation location. 54% of respondents reported that the Foothills trails are their primary recreation location (n=339).

In an effort to understand other locations where Foothills trail users recreate, respondents were asked which recreation passes they had. 90% had a Discover Pass which allows for recreation on Washington state lands including state parks and the Washington Department of Fish and Wildlife lands (n=277). 47% have a Northwest Forest Pass, which allows access to improved trailheads on Forest Service trailheads in Washington and Oregon. 29% of respondents had an interagency pass for federal lands including all Forest Service, Bureau of Land Management and United States Fish and Wildlife areas nationwide. 11% reported having Sno Park passes, which are required at some maintained parking areas for snow-based recreation in Washington State. 4% had other kinds of passes, including passes for Chelan County PUD recreation parks. The results of this question can also lead to future research regarding the value users place on recreating at the Foothills using willingness to pay models with pass values as proxies.

**Activities**

Respondents were asked to list all activities they participate in on Foothills trails (Figure 17). Respondents could select more than one option. Hiking or walking on the trails was the most common activity, with 88% of respondents reporting participation on the Foothills trails. 38% of respondents reported using the trails for mountain biking and 37% trail run on the trails. 2% reported horseback riding, and 1% reported using the trails

for other activities, write in responses included snowshoeing and volunteering (n=340). Over half, 54%, of users participate in multiple activities on the trail system.

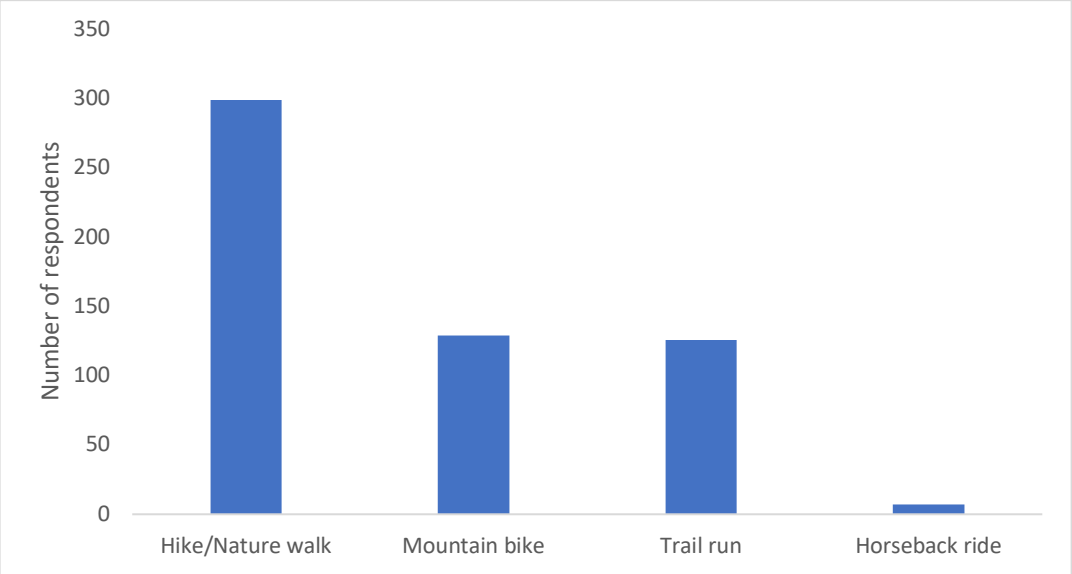


Figure 17 Activities respondent participates in on the Foothills trail, respondents could select more than one answer option.

**Motivations**

Respondents were asked to rate their motivations for using the Foothills trails (Figure 18). Respondents could select more than one motivation and were instructed to select up to three. Exercise was the most common answer with 92% of respondents selecting that as one of their motivations for using the trail system. 65% of respondents use the trails to appreciate nature. 48% ranked being with friends and family as a motivation for using the trails and 39% use the trails to relax (n=338). Differing motivations for users can result in conflict; the level of consistency in Foothills trail user motivations indicates a low potential for conflict (Carothers, Vaske, and Donnelly 2001).

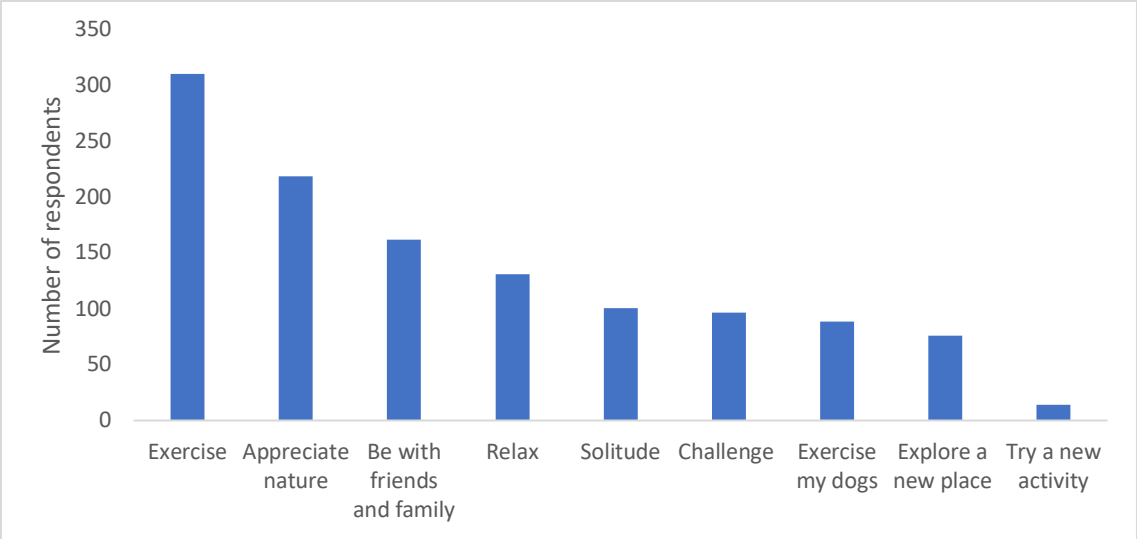

Figure 18 Motivations for recreating on the Foothills trails, respondents could select up to three answer options.

**Presence of dogs**

35% of respondents reported that they bring dogs when they visited the Foothills trails (Figure 19). Out of total users, 25% bring one dog, 8% bring two dogs, and 2% bring three dogs (n=330). Of users that recreated with a dog, 72%, had only one dog, 23% had two dogs, 4% reported bringing 3 dogs and no one reported bringing more than 3 dogs (n=112). 69% of respondents who brought dogs reported keeping their dogs on leash (n=116).

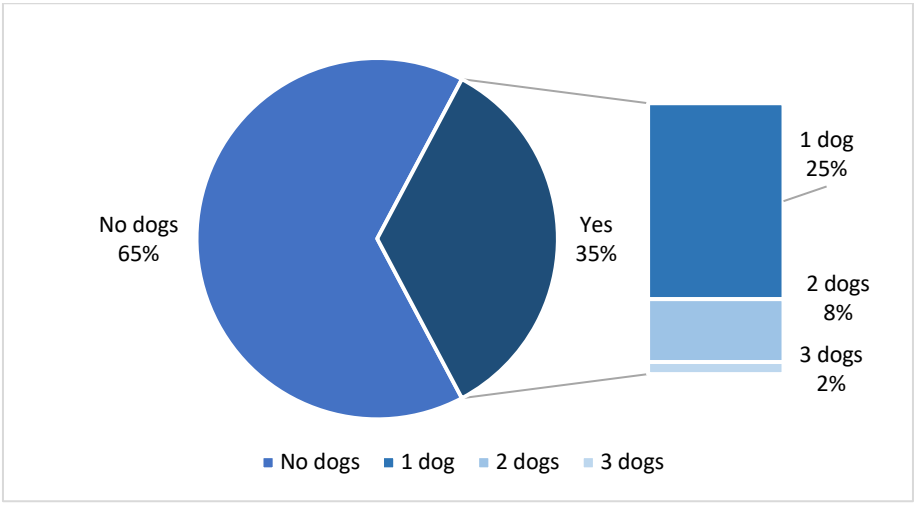

Figure 19 How many respondents bring dogs and how many dogs they bring.

**Use characteristics summary**

In 2018, Foothills trail users were most likely to be longtime users from the immediate area. Hiking was the most common activity, and about half of the respondents participate in multiple activities on the trails. Although most trails are open to horses, horseback riding is the least frequent activity. One-third of users bring dogs when they recreate. Exercise, appreciating nature, and being with friends and family are the top motivations for users to recreate on the Foothills trails.

*Specific trip characteristics*

Respondents were asked about their use of the Foothills trails generally as well as about a specific visit to the Foothills trail. For trailhead administered questionnaires, this was the visit that respondents were concluding that day. Respondents who completed the questionnaire online were asked to recall their most recent visit.

**Specific trip activities**

Taking a hike or a nature walk was the most common activity for users, with 61% of respondents participating (n=330). 21% of respondents were mountain biking on their specific trip. 16% were on a trail run. 2% were on the trails participating in another activity, most of the write in answers were volunteering. Less than one percent were horseback riding.

Specific trip activity was also analyzed by trailhead (Figure 20). Hiking is the most common activity at all trailheads except the Sage Hills. Mountain biking and trail running are the most common activities for the Sage Hills. Mountain biking makes up a larger proportion of total recreation at Horse Lake and Sage Hills than the other trailheads and is not allowed an authorized activity on the Castle Rock trails.

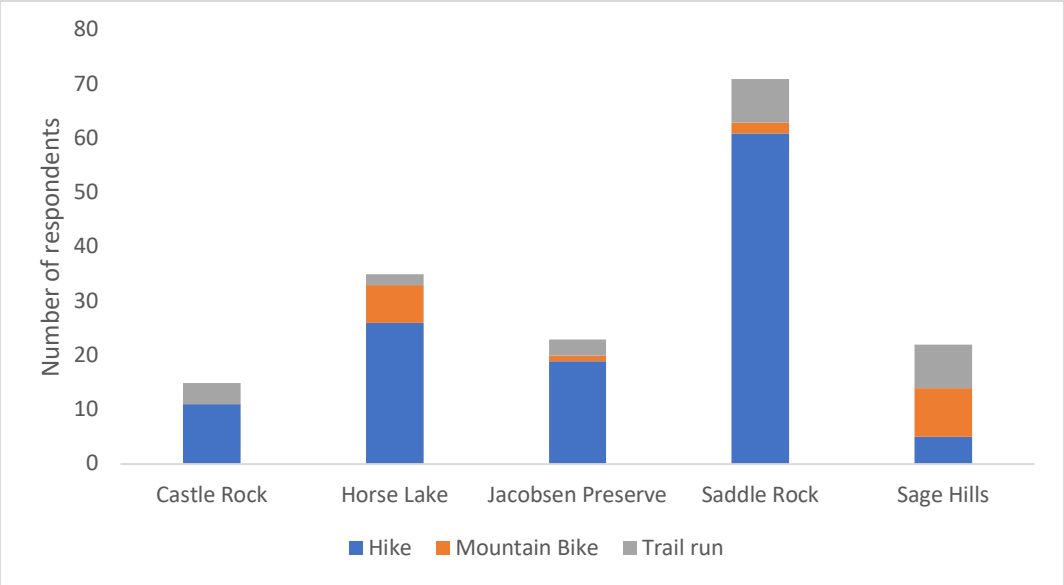

Figure 20 Specific visit activity by trailhead (n=166). This only includes data from trailhead administered questionnaires.

**Party size**

The majority of trail users appear to travel solo or in a pair, with 39% of respondents reporting a party size of one, and 36% reporting a party size of two (n=305). 13% were part of a group of 3 and 7% were a party of 4. Groups of 5-14 users were 4% of users and only 1% of users were part of a group of 15 or more (Figure 21).

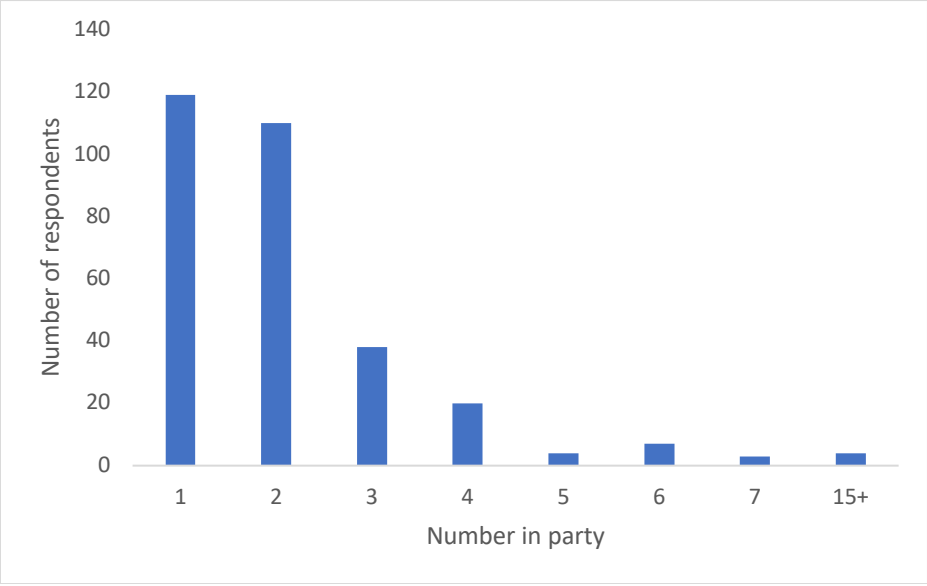

Figure 21 Number of people in party.

**Trip length**

Moderately short trips were the most common trip length, with 73% of respondents using the trails for 1-2 hours (n=330). 15% reported being on the trails 3-4 hours, and 11% used the trail for less than an hour. One percent reported spending 5-8 hours on the trail (Figure 22).

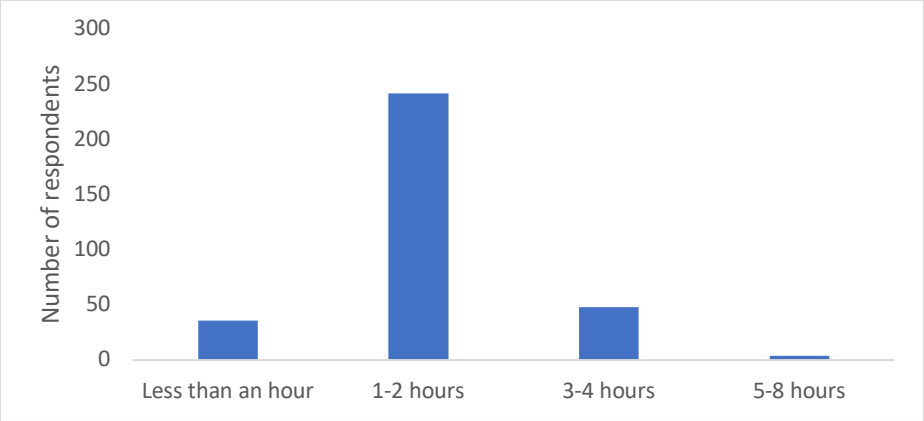


Figure 22 Length of trip.

**Trip location**

The Foothills trails include a number of officially "unauthorized" trails that have emerged due to social use. These unauthorized trails are not maintained by the land owners or included on official trail maps. However, they may be user maintained and appear on trail apps and popular websites. Unauthorized trails include redundant trails, as well as trails have been created to fulfill a desired area of travel that is not met by the existing trail network. Some of these unauthorized trails are on the Chelan County PUD Home Water Wildlife Preserve, which requires approval from the Federal Energy Regulatory Commission to increase the number of trails. A question was included on the questionnaire to see how aware users were of authorized and unauthorized trails. Most users, 86%, reported traveling on only authorized trails, while less than one percent

reported traveling on only unauthorized trails (n=322). 7% of respondents traveled on both authorized and unauthorized trails, and another 7% were not sure about what type of trails they traveled on.

*User perceptions*

Questionnaire respondents were asked a series of questions about conditions and perceptions to evaluate conflicts between users and management practices.

**Understanding of management**

Respondents were asked who they would contact if they had a question or comment about the trail system. An open-ended text box allowed respondents to enter multiple organizations or agencies. Chelan-Douglas Land Trust was listed by 71% of respondents (n=160). The City of Wenatchee was listed by 3% of users. Several outdoor organizations including Wenatchee Outdoors, Washington Trails Association, Evergreen Mountain Bike Alliance and Run Wenatchee were all listed by 1-2% of respondents.

**Trail conditions**

The first question about trail conditions had questionnaire respondents rate characteristics of trail design and maintenance on a scale from excellent to terrible, with the additional option of did not notice (Figure 23). Ratings of good or excellent were coded as acceptable. Ratings of poor or terrible were coded as unacceptable and in need of attention. Trail width and steepness and vegetation were all rated as acceptable: 78% of users rated width above average (n=321), 81% of users rated steepness above average (n=312), and 73% of users rated vegetation above average (n=311). Signage had lower ratings. 48% of users rated the amount of signage on trails excellent or good, 23% rated it average, and 24% of users rated signage as unacceptable (n=311). Information on signage

was rated similarly: 51% of users found the information on signage acceptable, 25% rated it average, and 18% rated information on signage unacceptable (n=307).

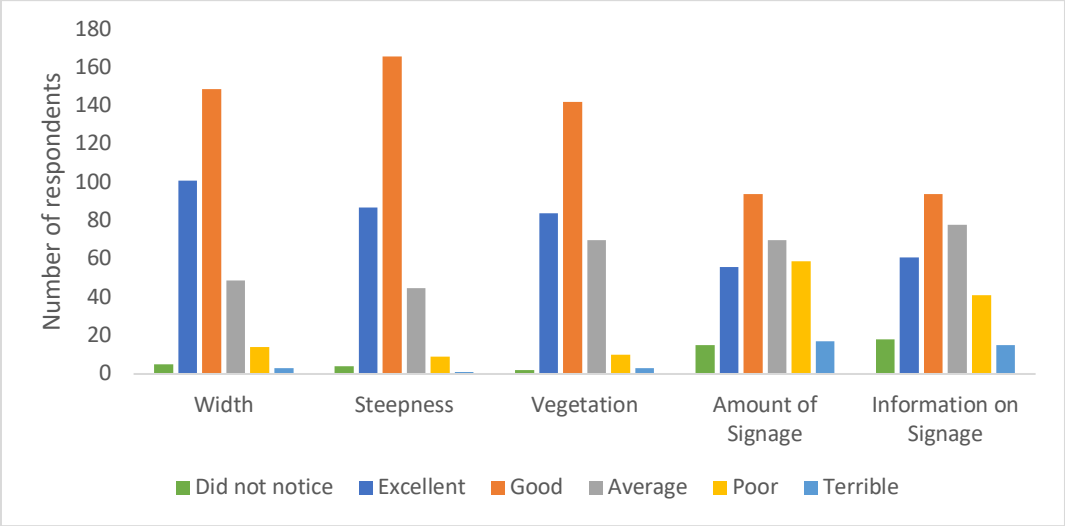


Figure 23 User ratings of trail conditions.

The second trail condition question asked about trail conditions impacted by recreation users (Figure 24). Conditions were considered acceptable if they were rated as expected amount, a little, or none. 72% of users rated bicycle ruts as acceptable (n=303), 75% of users rated horse tracks acceptable (n=303), 80% rated manure as acceptable, (n=301) 84% of users found trash levels acceptable (n=302), and 80% rated the presence of dog poop as acceptable (n=317).

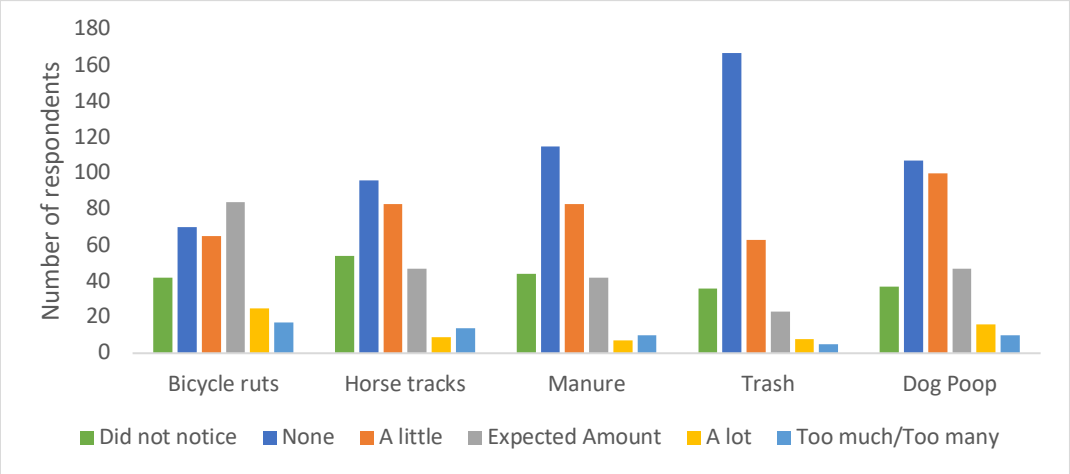


Figure 24 User ratings of trail conditions.

**Trail system infrastructure**

In addition to trail conditions, the questionnaire asked respondents to rate their perception of trailhead conditions. Trailhead amenities were generally found to be adequate. 70% of users found toilet facilities adequate (n=315). Trash can availability was rated adequate by 63% of respondents (n=310). Trailhead amenities vary by trailhead as discussed in the study area section. Survey results from the trailhead sample were analyzed to identify which trailheads had inadequate ratings. The Sage Hills trailhead had the most inadequate ratings for toilets (57%), trash cans (38%), and signage (25%). This corresponds to Sage Hills being a low amenity trailhead and suggests there is user demand for a medium or high amenity trailhead at this location. 29% of Jacobsen Preserve users found trash cans inadequate at the trailhead and 25% of Horse Lake users found trailhead signage inadequate, suggesting improvements can be made at these trailheads as well.

**Conflict**

A question was included on the questionnaire to see how often users had conflicts with other users on trails during their specific visit (n=316). The overwhelming response was no, with 97% of respondents reporting they had experienced no conflict, and 3%, 11 users, reporting experiencing a conflict with another user on the trails. The 3% that reported experiencing a conflict were asked to list what type of conflict they had and six users listed their conflicts. Most conflict responses were from violations of use regulations. Three reported conflicts were encountering off leash dogs, one conflict was "almost was run down by a mountain biker", and one conflict was seeing horses traveling

off trail. One conflict was due to differing motivations with the user listing "one lady in our group hike kept wanting to go faster."

Users were also asked if they encountered off leash dogs during their trip on the trails (n=319). 67% of respondents reported no encounter with off leash dogs, while 33% reported encountering off leash dogs.

**User perceptions and experience summary**

Users are largely satisfied with trail conditions and trailhead amenities. Although respondents rated signage as acceptable, amount of signage and information on signage received the highest amount of poor or terrible ratings, which suggests a need for further attention.

The low level of reported conflict suggests that conflict between users is not currently an issue for the trail system. Conflict level will be interesting to monitor in future questionnaires if conflict emerges as an issue. The percent of encounters with dogs off leash corresponds with the percentage of users that reported bringing their dogs off leash.

*Comments*

121 respondents wrote in open-ended additional comments. These comments were read and coded by common themes, some comments contained multiple themes. The most commonly expressed theme was gratitude for the trail system. Other frequently repeated themes included signage, trail head amenities, expansion and access and dogs off leash. Signage comments were largely requesting more directional signage, but commenters also suggested more informational signage about local ecology, history of the area, and geology. Users expressed the wish for more trails, conversely some

commenters wanted to make sure expansion wasn't rushed. 13 comments mentioned dogs off leash and reported conflicts with off leash dogs in the past as well as requests for approved off leash trails.

## Spatial analysis of use patterns

Users marked the route of their most recent trip to a Foothills trail by selected each trail segment they traveled on or drawing the off-trail path they took. Analysis of use patterns revealed which trail segments had the highest use overall, as well as by each activity type (Figures 25 through 28).

This analysis shows high density of use on the Saddle Rock main trail, Sage Hills trail, and the Homestead, Glacier View, and Ranch Road trails at Horse Lake. This corresponds the highest proportion of trailhead responses occurring at the Saddle Rock trailhead, but differs from the low levels of use at the Sage Hills during questionnaire trailhead sampling periods. Usage is lowest on the Upper Apricot Crisp Trail, possibly due to its distance from a trailhead. Use of the upper Dry Gulch trails is also low, possibly due to the lack of a significant feature to visit and lack of loop options.

Use frequencies by activity also reflect questionnaire findings, with the highest participation in hiking, followed by mountain biking, and then trail running (Figures 26 through 28). Frequency for hiking use reflects the overall use pattern. Mountain biking has higher use frequencies on the northern trails than the southern trails. Running patterns are similar to the biking use patterns with an overall lower level of use. Several trail segments were popular for all activities. The Sage Hills main trail, and the

Homestead and Glacier View trails in the Horse Lake area are segments of frequent use by hikers, mountain bikers, and trail runners.

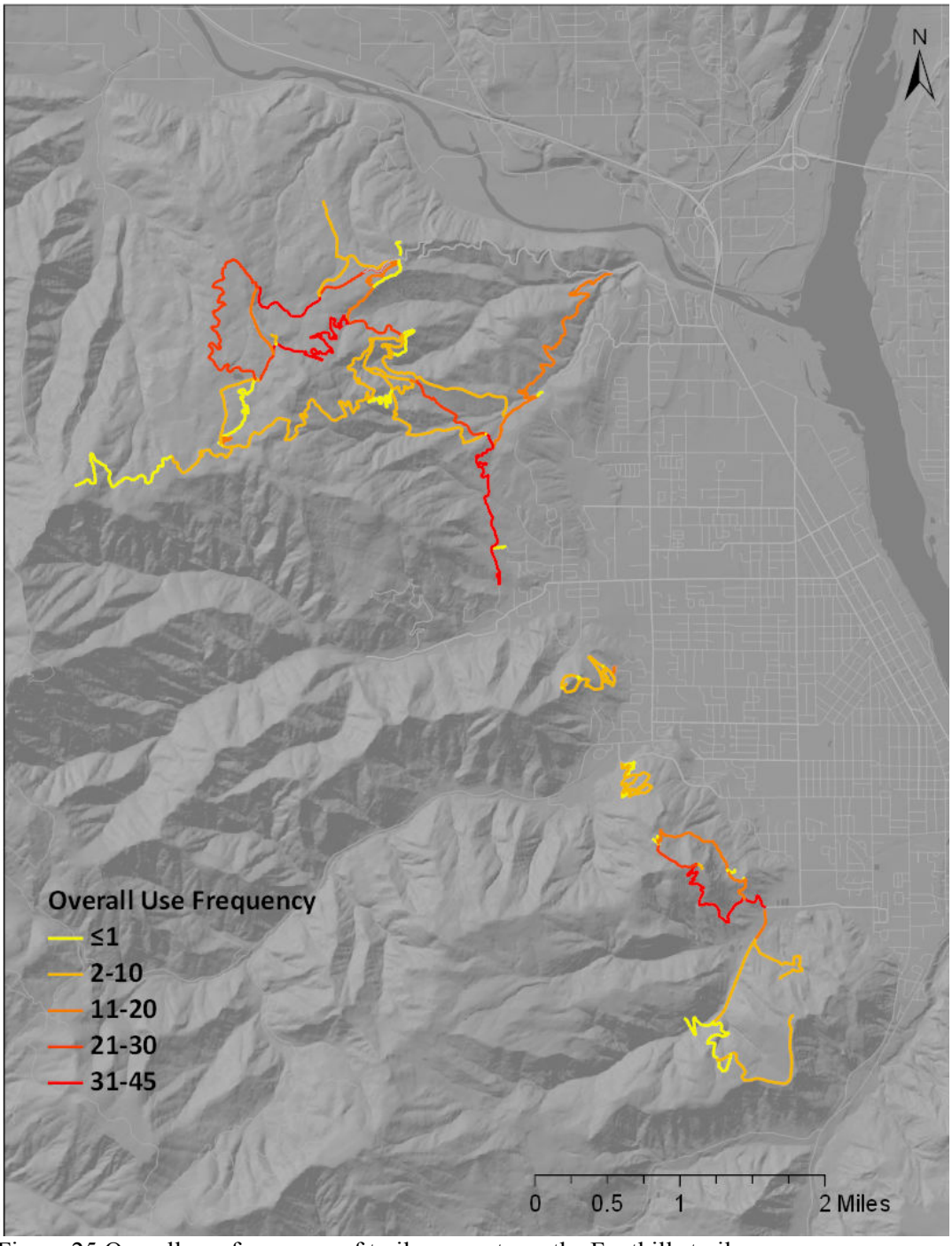


Figure 25 Overall use frequency of trail segments on the Foothills trails.

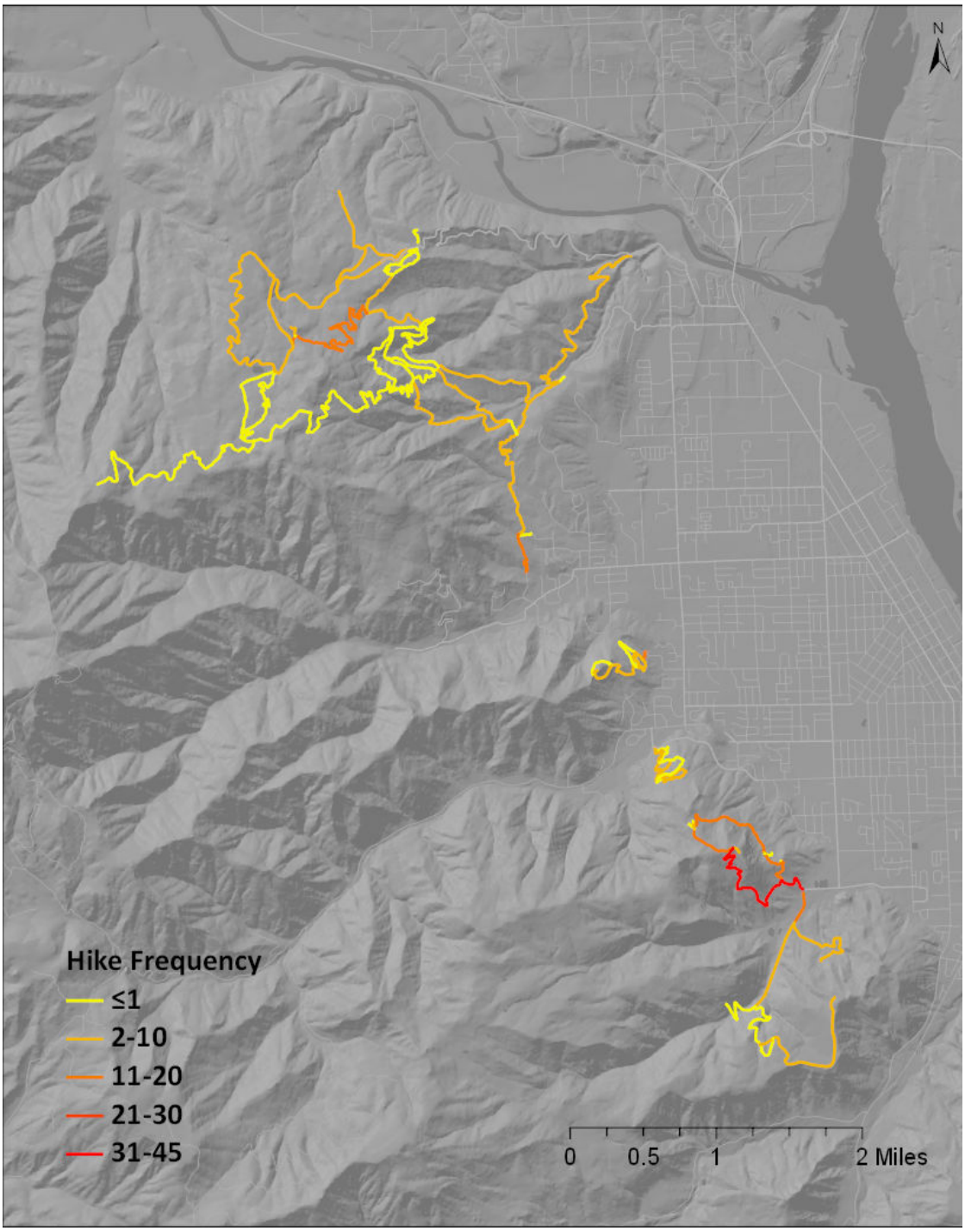

Figure 26 Hiking use frequency of trail segments on the Foothills trails.

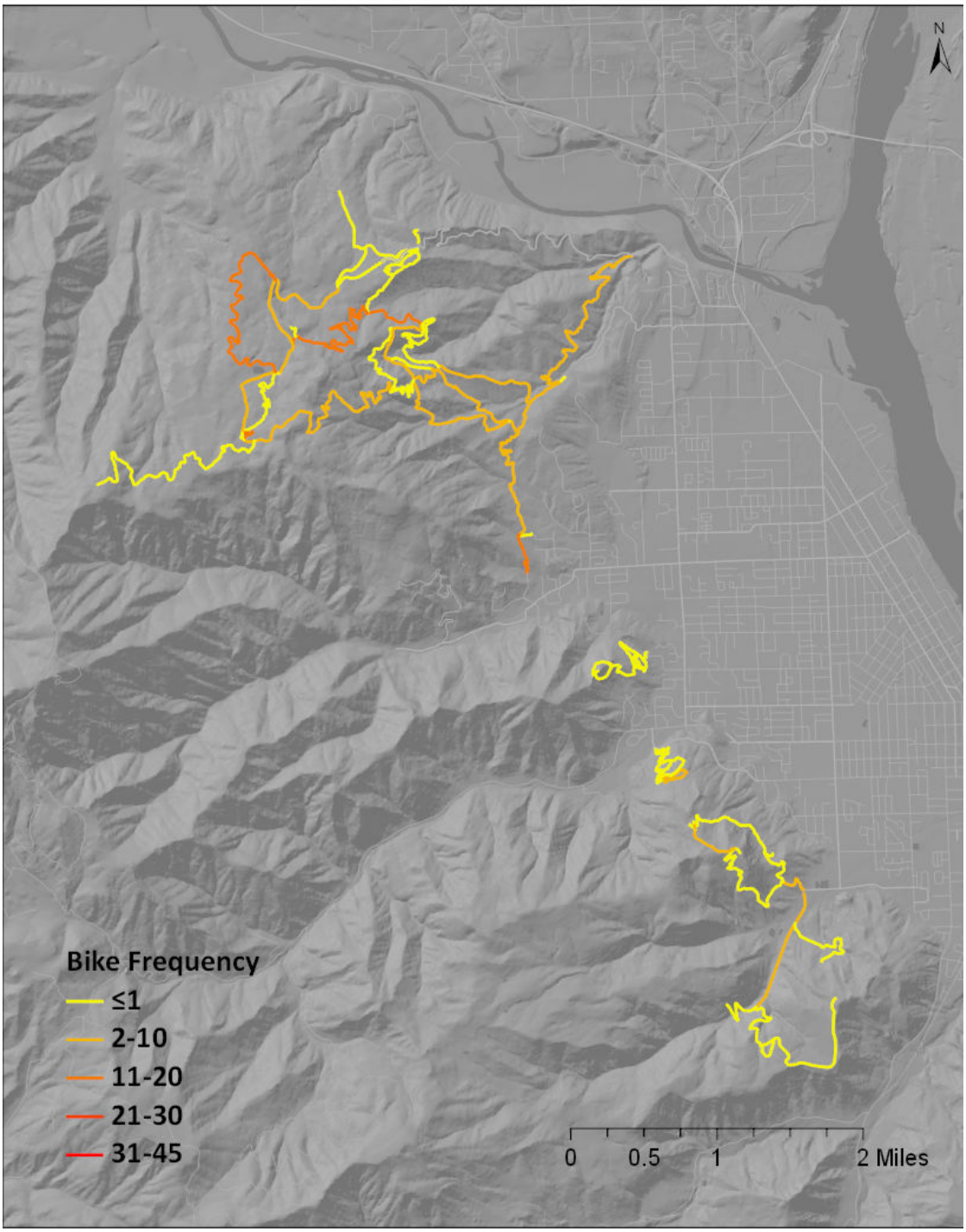


Figure 27 Biking use frequency of trail segments on the Foothills trails.

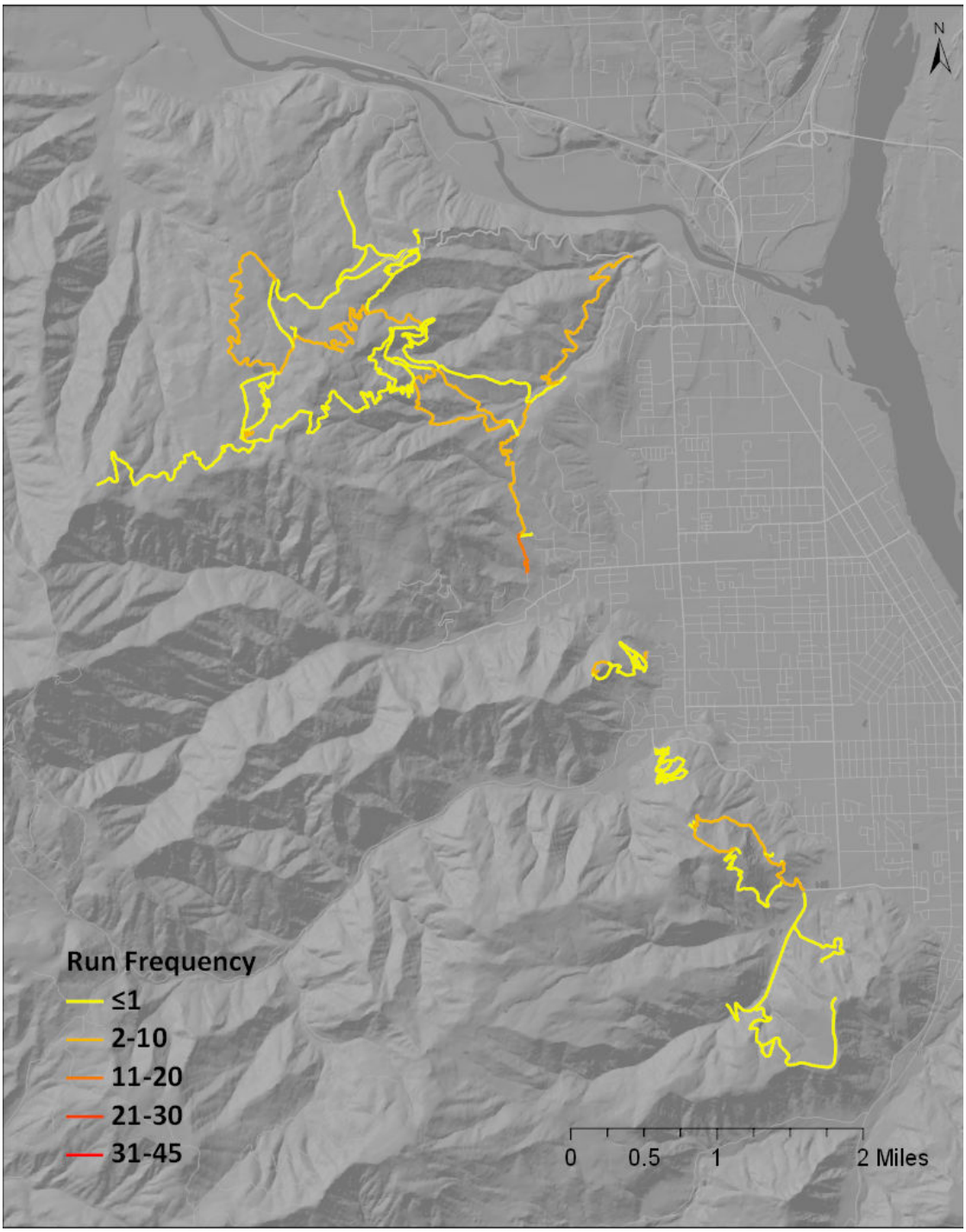


Figure 28 Running use frequency of trail segments on the Foothills trails.

Usage of authorized and unauthorized trails on the PUD parcel of the Sage Hills was of particular interest due to the potential to officially add trails to the system through a FERC approval process before the Rock Island dam is relicensed in 2028. Analysis of use patterns for this area shows that the highest concentration of use occurs on the authorized trail (Figure 29). However, 59% of users who took a route that crossed the property used at least one unauthorized trail segment. Users travel on authorized and unauthorized east-west trails, and there is some redundancy of north-south options in the north central portion of the property. The lack of use on the middle section of trail, in yellow, is most likely due to users not selecting that segment on the questionnaire due to misreading the map and missing that segment, as it is a connector segment for the moderately used trails surrounding it.

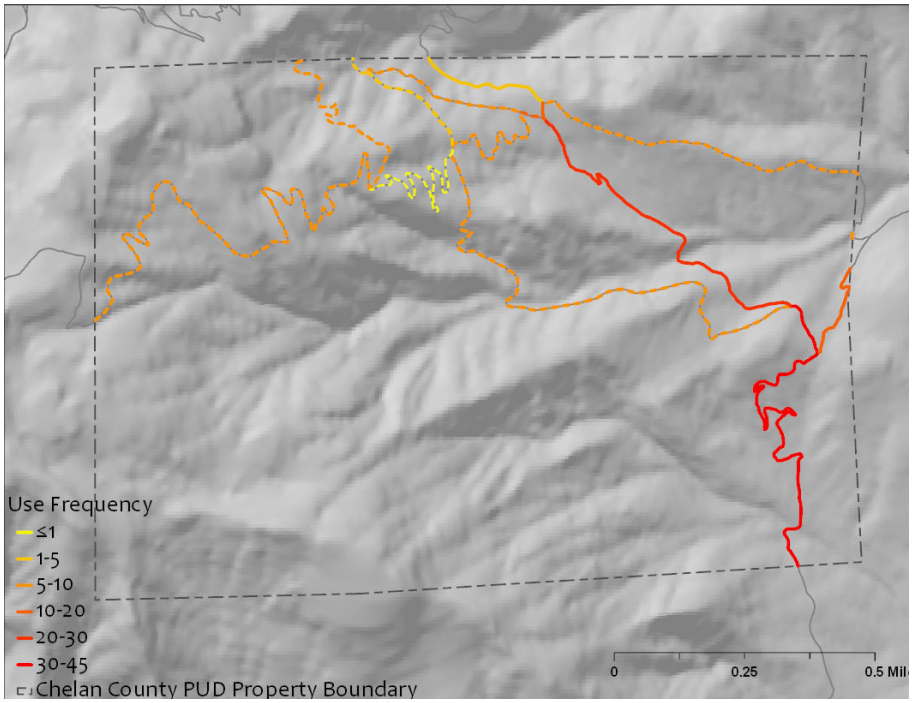

Figure 29 Frequency of trail use on trails on the PUD property of the Sage Hills, with unauthorized trails represented by dotted lines.

The spatial analysis of use patterns provides a detailed look at where users go within the trail system and identified frequently used trail segments. Interestingly, despite the overlaps in frequently used segments between activities, users reported low rates of conflict. This may indicate that use levels have not reached a critical level and that users are considerate of other users. This spatial understanding of users' engagement with the trail system could be combined with trail condition assessments to understand the relationship between use and impacts within the system.

# CHAPTER VI

# DISCUSSION AND CONCLUSIONS

This study set out to answer the questions: 1) How do management goals of cross boundary land owners for the Foothills trail system compare? and 2) What are the types of trail use, patterns, and perceptions of users within this patchwork management and what are the resulting management implications? The research questions were addressed through identifying the different land owners and their management goals along and within the Foothills trail system and creating and distributing a questionnaire to collect user data on user characteristics, use patterns, and user perceptions of conflicts and trail conditions throughout the Foothills trail system. This chapter will synthesize the results from chapter 5 to provide document analysis and questionnaire findings, management recommendations, and directions of future research.

## Discussion

### *Management goals*

Analysis of the management goals for the landowners within the Foothills trail system identified differences in the priorities of management and in the level of autonomy of land owners. These differences, as summarized by Table 3 (page 59), revealed the gap between the City and CDLT, who prioritize public access and recreation, and the PUD and private landowners, who prioritize wildlife habitat and open space. The analysis identified the formalized management agreements that exist between the City and the PUD regarding use of the authorized Sage Hills Trail, and the legally

binding conservation easements between CDLT and the private land owners. The analysis revealed the lack of formalized cross boundary management agreements between the City and CDLT. Additionally, the system lacks an overarching management plan that is developed and supported by all land owners and implemented and evaluated through an established management process.

The Foothills trail system would benefit from a recreation management process that includes evaluation with monitoring and feedback-informed from users to support management modifications, as summarized by Figure 30.

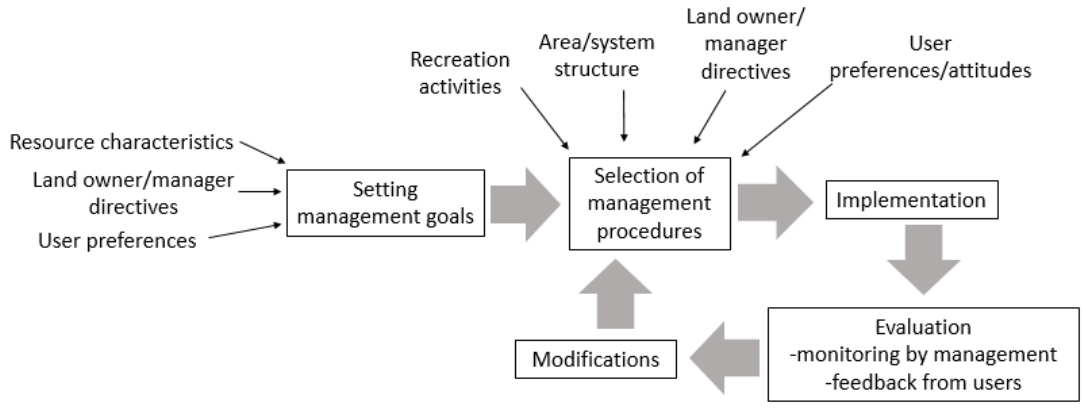


Figure 30 Recreation management process, adapted from Pigram and Jenkins 2006 and Brown 1977

The process begins with setting management goals that are informed by resource characteristics, land owner management directives, and user preferences. This step has been achieved in the Foothills as evidenced by the establishment of the trail system as nonmotorized to minimize heavy vehicle impacts due to landscape characteristics and the inclusion of users and stakeholders in early planning discussion in the 2000s. From this initial step, management strategies are selected, with consideration to recreation activities that will occur, the structure of the area, and land owner directives and goals. The second

step has also been seen in the Foothills system with the consideration of multiple user types, like hikers and bikers, and different regulations for areas that are physically isolated. This selection of management strategies is followed by implementation.

The next step is evaluation, and this is an area the Foothills trail system could improve upon for future management. Evaluation includes the monitoring of users and of trail conditions, and as recommended below, setting acceptable levels of trail conditions and user satisfaction and specific indicators to monitor these objectives is key to the evaluation process. This evaluation allows the next step to occur: modifications to the management strategies. Potential modifications, as recommended from the survey results from this thesis, is considering the authorization of additional trails in the Sage Hills area and developing consistent signage throughout the system. Recommendations are discussed in more detail in the Management Recommendations section.

### *Questionnaire*

The results of the questionnaire provide baseline data for who Foothills trail users are and how they use the trail system. Users are overwhelmingly local, with 80% from Wenatchee or East Wenatchee. The largest contingent are longtime users, 34% of have been using the trail for 9 or more years, but there is a substantial population of new users, 26% of users have used the trail system for 2 years or less. Users recreate on the trail system frequently with 55% reporting at least weekly usage, and 77% using the trails at least monthly. The Foothills trail system is the primary recreation location for 54% of users.

Demographically, users are almost equally male or female, and 52% were 26-45 years old. Users predominantly identified as Caucasian, 75%, while 16% identified as

Latino. This is slightly disproportionate to the census estimates for Wenatchee/East Wenatchee of 70% Caucasian residents and 30% Latino residents. Total annual household income was $100,001 or more for 30% of users. The median household income for Wenatchee and East Wenatchee was $50, 251 according to 2017 estimates (United States Census Bureau 2017c).

Hiking was the most common activity with 88% of users participating. Nearly equal amounts of users participate in mountain biking, 38%, and trail running, 37%. Over 50% of users participated in multiple activities. Exercise was the most common motivation for trail users. Users most often recreate solo (39%) or with one other person (36%), 35% bring dogs to the trails, and 88% of users are on the trail for 2 hours or less.

Users found trail and trailhead conditions and amenities largely acceptable. Trail width, steepness, and vegetation were all found acceptable by over 70% of trail users. Amount of signage and information on signage was acceptable by 48 and 50% of users, respectively. The amount of bicycle ruts, horse tracks, manure, trash, and dog poop were acceptable by 70% or more of users. Negative interactions between users were found to occur at low rates, with 3% of users reporting conflicts with other users. Off-leash dogs were encountered by 33% of users.

Spatial analysis of use patterns show the highest use segments are Saddle Rock Main Trail, Sage Hills Trail, Homestead Trail, and Glacier View Trail. Spatial analysis indicates that the highest concentration of use (30-45 users) occurs on authorized trails, but a substantial amount of use (10-20 users) occurs on the unauthorized trails.

## Management Recommendations

Analyzing the management goals and survey results identified several areas for management to address, including creating a more clarified and formalized overall management plan, developing a user data collection plan, increasing signage, and authorizing additional trails. These recommendations should be incorporated into the management process described above to inform modifications to selecting management strategies. Recommendations are discussed in detail below.

### *Recommendation for clarified and formalized management plan*

This study identified the goals of land owners and reveals the need for a cohesive management plan to coordinate the differing management goals that exist for land owners within the system. While each owner has their own management plans, no overarching plan has been written since the visioning documents created a decade ago (City of Wenatchee 2007; The Trust for Public Land and CORE GIS 2010). A coordinated management plan for the whole Foothills trail system is needed to ensure its sustained success, which can be evaluated by keeping impacts at or below levels that are acceptable to all land owners and reducing the potential for user conflicts.

This cross-boundary management plan should include specific objectives for acceptable levels of impact and acceptable trail conditions. This study found that trail conditions are acceptable to users, but those conditions might differ from land managers' objectives. The plan should also contain specific objectives for user experience. User experience objectives may include levels of conflict and user satisfaction with conditions. Establishing specific objectives would guide the selection of appropriate management strategies and facilitate effective evaluation.

The management plan can also define relationships between owners and formalize agreements. Although they are the most active managers of the trails, the City and CDLT operate under an informal agreement with each other. Formalizing the management agreement between CDLT and the City for trail and trailhead management is recommended for the long-term success of the system, in terms of both user awareness of management and sustainable use. The survey results revealed that CDLT is seen as the trails contact and clearly communicating the roles and responsibility of land owners to users through education and outreach would benefit the system.

*Recommendation for developing a user monitoring plan*

Use of the trail system is expected to increase due to increasing populations in the Wenatchee area and increasing participation in recreation activities statewide. Having a management plan that incorporates collecting user data will enable evaluation of the management plan's success and how actual use characteristics compare to the assumed use characteristics.

This study collected baseline data through the creation and distribution of a user questionnaire. The true value will come in future years with further iterations, and the overall management plan should incorporate systematic gathering of user data. Establishing a visitor monitoring routine that includes administering a survey every 4-5 years is recommended. This interval is common for other urban-adjacent, patchwork property ownership trail systems (City of Flagstaff 2012; VanderWoude and Kellogg 2018). Periodic sampling allows for changes in use trends to be identified while avoiding collecting data too frequently and lacking resources for survey development and analysis or fatiguing respondents.

Conflict between user groups is a common concern for multiuse trail systems and has been anecdotally reported to land owners on the Foothills trail system. As such, rates of conflict occurrence was an issue of interest for land managers when developing the questionnaire. Results showed that conflict between users is perceived as low, with only 3% of respondents indicating experiencing a conflict with other users during their trip. This issue should continue to be monitored by questionnaires in future years, and an increase in conflict is seen that could indicate a need for identifying why the management intervention. Conversely, consistent low rates of conflict would indicate that management for multiple-uses is effective. Potential areas for expanding the questions about conflict are discussed in the future research section below.

Dog presence, and compliance with on-leash policy was another area of concern for land managers. Questionnaire results indicate 69% of users that bring dogs leash them, and 33% of all users encountered off leash dogs. This level of compliance, in addition to the lack of users reporting off leash dogs as a conflict, could be accepted as satisfactory. However, managers could pursue increased compliance through added enforcement strategies, education, or altering policies.

The 2018 questionnaire form should be used as a framework for creating future versions, with the same overall sections of the questionnaire: use characteristics, demographics, and user perceptions and opinions. However, condition questions can be modified to solicit responses on particular issues of interest. There has been increasing interest of the economic contributions of recreation in Chelan and Douglas counties, and a general study has been conducted. Future questionnaires could include questions about

recreation-related expenditures for local and visiting users to better determine the specific economic contributions of the Foothills trail system.

User perceptions on specific issues could be obtained through questionnaires conducted at more frequent intervals if an issue arises that needs more current information or information not captured by the periodic questionnaires. Additionally, future questionnaires should be developed in collaboration with all landowners and other stakeholders to incorporate topics of interest and concern to maximize information received from respondents while minimizing respondent fatigue.

CDLT maintains electronic counters at two trailheads currently, but they have never been calibrated accurately. It is recommended that electronic counters be calibrated, or another counting method adopted (Cope, Doxford, and Millar 1999; Loomis 2000). Accurate counts of daily users would allow future questionnaire results to be applied proportionately to the use counts. Counts would also allow for temporal patterns in use to be identified.

*Recommendation for consistent signage*

All trail conditions were found acceptable by users. However, the perception of the amount of signage and the information on signage throughout the trail system were rated with the highest level of unacceptable ratings and was the subject most mentioned in open response comments. The questionnaire results of users' perceptions of signage imply the need for a unified approach to signage throughout the system. The use pattern results also indicate that usage is high across all methods of travel (hike, bike, or run) along the same segments, this may be due in part to a lack of signage and understanding of the trail system. Signage amount and style varies throughout the system.

Developing and implementing a consistent trail signage plan is recommended. The plan should focus on increasing signage within the trail system as trailhead signage was found to be adequate by a majority of users. Trail signage should include directional signs placed at all trail junctions indicating the names and directions of the trails. Wayfinding signs, with a locator map, should be placed at more significant junctions where three or more trails meet. Explanatory signs should be posted where trails cross onto different property boundaries and different regulations apply. This already occurs at Castle Rock, but could be improved in other areas of the trail system.

Due to characteristics of the shrub-steppe ecosystem and dry climate, vegetation does not regrow easily, leading to a high number of user created trails and decommissioned trail scars. Closures require substantial resources to be effective. Closure signs are needed for all unauthorized and decommissioned trails and active rehabilitation through plantings and placement of barriers is recommended to discourage use. Removing unauthorized trails from trail information sources like regional recreation guidebooks, online and printed, and trail apps is also recommended if trail closures are to be successful.

*Recommendation for additional authorized trails*

The results of the use pattern frequency of usage within the Home Water Preserve lead to the recommendation that an additional north-south trail be approved and remaining trails be closed with active rehabilitation efforts. Selection of the north-south trail to incorporate should be determined by looking at topography, existing trail condition and design for future sustainability, and consultation with user groups.

Closure of unauthorized trails provides additional feasibility and resource challenges. These include the financial resources for implementing the closure strategies such as constructing barriers and replanting native species. Equally challenging is educating users about the closures and enforcing the trail closures. Many of the unauthorized trails within the Foothills system are included on trail apps and online guidebooks that include user-contributed routes. Successful closures would require identifying information sources that publicize the routes and working with the sources to remove unauthorized routes and educating users about the closure locations and reasons.

Pursuing the addition of an authorized trail in the Home Water Preserve area should be a priority for land owners as this would require consultation to determine if an additional trail would negatively impact wildlife habitat before the trail could be considered for approval by the FERC. The PUD has expressed the desire to resolve before they begin the relicensing process which will conclude in 2028.

*Recommendation for conducting trail condition assessments*

Trail conditions should also be monitored through periodic assessments to track changes. There are many established methods of assessing trail conditions including continuous and point sampling for chosen parameters such as width, incision, exposed rocks and roots, and areas of mud (Leung and Marion 1999; Marion and Leung 2001; Wimpey and Marion 2010). Integrating the user pattern results with evaluations of trail conditions and user count data would allow the relationship between impacts and use frequency and type of use to be defined. Understanding levels of use and impacts would improve the effectiveness of management and maintenance plans.

## Future research

This study provided baseline user data for Foothills trail users, and there are many potential directions to further understanding of the trail system through future research including studies focused on spatial use patterns, economic value of the trail system, conflict occurrence, and further statistical analysis.

Studies focused on spatial patterns are an emerging area of recreation ecology research and the spatial component of this study has high potential for future research. Adding a temporal and seasonal component to the study of user patterns would strengthen the understanding of how users engage with the trail system. An additional question attached to the questionnaire revealed that there is a substantial population of users that track their use of the trails with GPS technology and would be willing to share their tracks for future studies. Recent work has also shown the ability of using data from geo-located photography and activity logs, such as Flickr and Strava, as proxies for use counts and use pattern analysis (Sonter et al. 2016; Headwaters Economics 2018). Continuing to capture patterns of use is an important component of monitoring for the trail system and exploring the accuracy of new collection methods is an area for future research.

The study included one question about directly experienced interpersonal conflict. Results reported only 3% of users experienced conflict. However, many different types of conflict exist including indirect conflict, social values conflict, conflicts between users and wildlife, and conflicts that occur between users and management either directly or

indirectly. A more comprehensive study on the types and levels of conflict experienced by Foothills trail users would provide valuable insight on the trail system.

As mentioned previously, the economic contribution of recreation to the regional economy is of interest. The survey question regarding recreation passes could be used in a willingness to pay study to evaluate the economic value users place on the Foothills trail system.

The user data would also benefit from further statistical analysis for significance especially in comparing responses between user groups such as activity types and area of residence. Identifying any significant changes in results between this study and future user studies will also be important. Finding significance was beyond the scope of this research but is an important component for future research.

## Conclusions

The purpose of this research was to identify management goals and collect user data for the Foothills trail system. This study accomplished those objectives and provides a critical baseline dataset for user profiles, use patterns, and user perceptions on the trail system. There were limitations in the study design, including a limited sampling period and the lack of statistical analysis. Despite these limitations this study provides valuable information to the management of the Foothills trail system and provides opportunities for future research. This research was disseminated through presentations and reports given to the land owners and Wenatchee Valley TREAD, and at a public presentation at Central Washington University's Symposium on University Research and Creative Expression (SOURCE) 2019. Beyond the Foothills trail system, this study can be

incorporated into studies of recreation in the north central Washington region and analyzed with user data from other trail systems for comparative studies.

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Appendix A. Copy of Survey

# 2018 Foothills Trail Survey

Start of Block: Informed Consent

Q1 Please read the following information about this research study and click the "I accept" button at the bottom of your screen if you are interested in participating. The following survey is part of a study on use of the Foothills trail system. You have been selected to participate in this study because you are using the Foothills trails today. We are gathering baseline data about users of the trails to inform future planning needs, apply for funding, and track trends in use. All Foothills trail users are invited to participate and you must be 18 years or older to participate in this survey. This web-based survey will take approximately 5-7 minutes to complete. There are no direct benefits to participating, however, by choosing to participate you will help expand knowledge about how people recreate on the Foothills Trails and identify needs for future trail maintenance and construction, and trailhead infrastructure needs. Your decision to participate is strictly voluntary and there are no anticipated risks, physical discomforts, or psychological stresses associated with these research procedures. You are free to answer all, some or none of the questions on the survey. You may withdraw from participating at any time and to do so you simply close your internet browser. Declining to participate will involve no penalty to you. If you submit a survey, your responses are recorded without any personal identifiers, so your responses are completely anonymous. We hope to gather approximately 500 responses. Data will be stored on a secure server and can only be accessed by the research team. **Reasonable and appropriate safeguards have been used in the creation of the web-based survey to maximize the confidentiality and security of your responses; however, when using information technology, it is never possible to guarantee complete privacy.** You can ask questions about the research by contacting Beth Macinko, Central Washington University, (860) 334-8983, beth.macinko@cwu.edu. You may also contact the CWU Human Protections Administrator if you have questions about your rights as a participant or if you think you have not been treated fairly. The HSRC office number is (509) 963-3115. Please click "I accept" if you are 18 years or older and wish to participate.

- ○ I accept (1)
- ○ I decline (2)

*Skip To: End of Survey If Please read the following information about this research study and click the "I accept" button a... != I accept*

End of Block: Informed Consent

Start of Block: Trail system use

For this survey, Foothills trails refers to any trails accessed from the Horse Lake, Maiden Lane, Sage Hills, Castle Rock, Jacobson Preserve, or Saddle Rock trailheads.

You may skip any question by clicking the red arrow pointing to the right. You may go back to change your answer to any question by clicking the red arrow pointing to the left.

Q2 Have you visited the Foothills trails before today?

- Yes (1)
- No (2)

*Display This Question:*
*If Have you visited the Foothills trails before today? = Yes*

Q3 About how often do you visit Foothills trails? (Please select one response)

- 4-6 times a week (1)
- 2-3 times a week (2)
- Once a week (3)
- 2-3 times a month (4)
- Once a month (5)
- 7-10 times a year (6)
- 4-6 times a year (7)
- 1-3 times a year (8)

*Display This Question:*
*If Have you visited the Foothills trails before today? = Yes*

Q4 How many years have you been recreating on Foothills trails? (Please select one response)

- 1-2 years (1)
- 3-4 years (2)
- 5-6 years (3)
- 7-8 years (4)
- 9+ years (5)

Q5 What activities do you participate in on Foothills trails? (Select all that apply)

- ☐ Hike/Nature walk (1)
- ☐ Mountain bike (2)
- ☐ Horseback ride (3)
- ☐ Trail run (4)
- ☐ Other (5) _____

Q6 What are your motivations for using the Foothills trails? (Select up to 3)

- ☐ Exercise (1)
- ☐ Be with friends/family (2)
- ☐ Exercise my dogs (3)
- ☐ Relax (4)
- ☐ Try a new activity (5)
- ☐ Solitude (6)
- ☐ Appreciate nature (7)
- ☐ Explore a new place (8)
- ☐ Challenge (9)

Q7 Do you bring dog(s) while you recreate?

- ○ Yes (1)
- ○ No (2)

*Display This Question:*
*If Do you bring dog(s) while you recreate? = Yes*

Q8 If you bring dogs, how many?

▼ 1 (1) ... 5 or more (5)

*Display This Question:*
*If Do you bring dog(s) while you recreate? = Yes*

Q9 Are your dogs ...?

- ○ on leash (1)
- ○ off leash (2)

Q10 Would you say that the Foothills trails are your primary recreation location?

- ○ Yes (1)
- ○ No (2)

Q11 Do you have any of the following recreation passes? (Select all that apply)

- ☐ Northwest Forest Recreation Pass (1)
- ☐ Discover Pass (2)
- ☐ Sno Park Pass (3)
- ☐ National Parks Pass/Interagency Pass (4)
- ☐ Other pass (5) _____

Q12 If you had a question or comment about the Foothills Trails, who would you contact?

_____

Q13 Do you track your recreation with a GPS app, like Strava, Runkeeper, etc?

- ○ Yes (1)
- ○ No (2)

*Display This Question:*
*If Do you track your recreation with a GPS app, like Strava, Runkeeper, etc? = Yes*

Q14 If you would be interested in being contacted to anonymously contribute GPS tracks for a potential future study, please enter your email below. (Emails will be disassociated from the rest of your answers to this survey). If not, please click the right arrow to continue the survey.

- ○ Email address (1)

_____

**End of Block: Trail system use**

**Start of Block: Trail experience**

The following questions refer to a specific recreation experience on the Foothills trails, please answer them based on your time on the trails today or your most recent trip.

Q15 What activity did you participate in on the Foothills trails today?

- ○ Hike/nature walk (1)
- ○ Mountain bike (2)
- ○ Horseback ride (3)
- ○ Trail run (4)
- ○ Other (5) _____

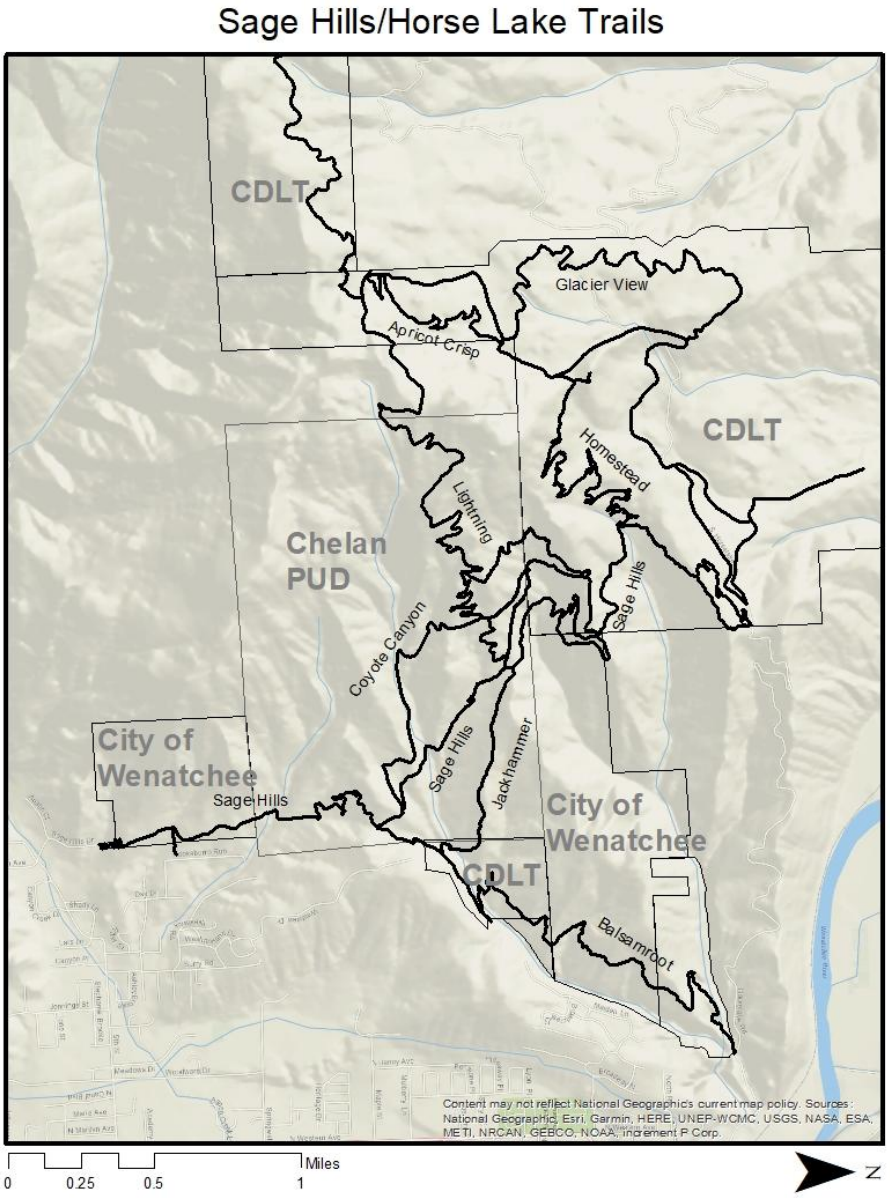
Q16 **Including you,** how many people are in your group today?

- ○ Party number (1) _____

Q17 How long were you, or will you be, on the trails today?

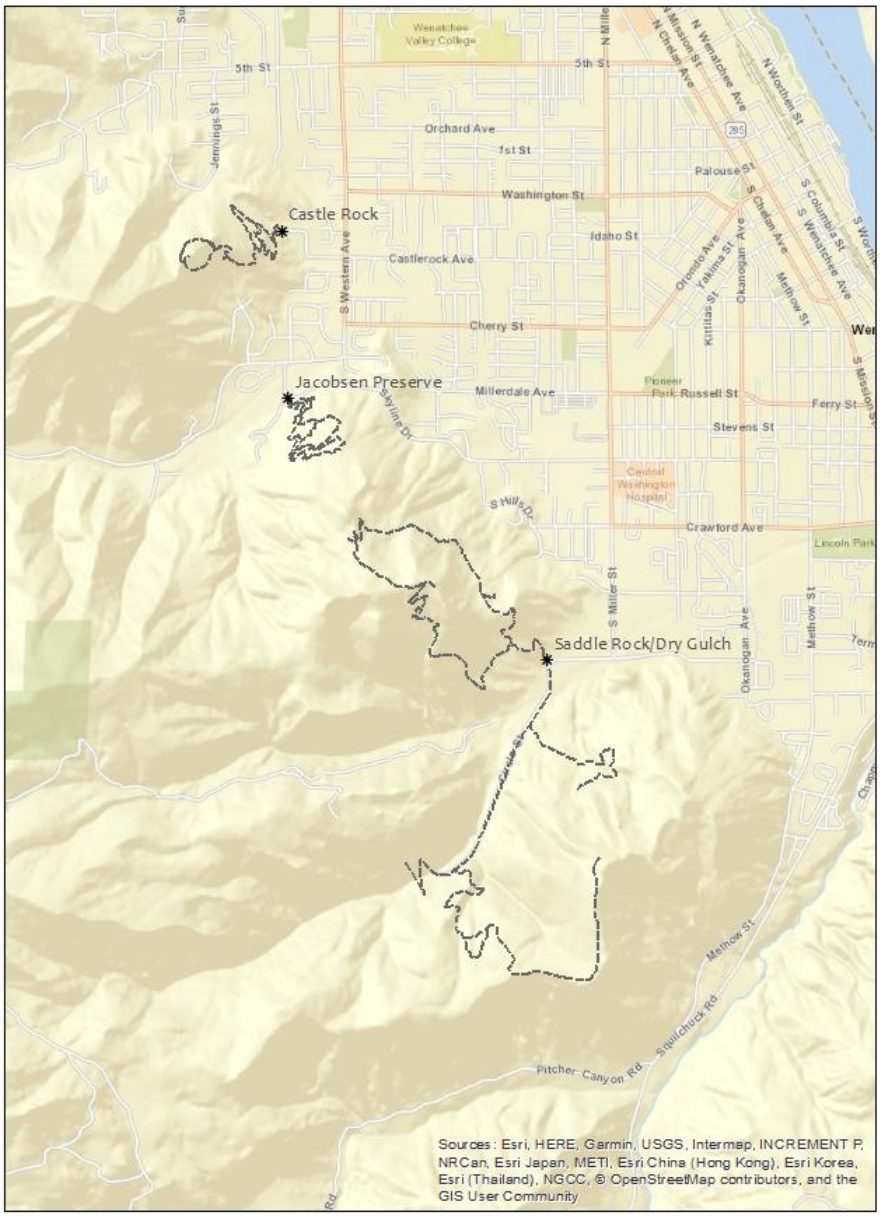
- ○ Less than an hour (1)
- ○ 1-2 hours (2)
- ○ 3-4 hours (3)
- ○ 5-8 hours (4)

Q18 If you were on the northern Foothills trails, use this map.
Mark the route you took today. Please click on each trail segment of your route. If you click in the wrong place, you can drag the circle to the correct trail segment.



Q19 If you were on the southern Foothills trails, please use this map.
Mark the route you took on the red trails today. Please click on each trail segment of your route.
If you click in the wrong place, you can drag the circle to the correct trail segment.

Castle Rock/Jacobsen Preserve/Saddle Rock



Q20 What did you think about trail conditions on the Foothills trails?
(Please select one value per condition)

| | **Excellent (1)** | **Good (2)** | **Average (3)** | **Poor (4)** | **Terrible (5)** | **Did not notice (6)** |
|---|---|---|---|---|---|---|
| Width of trail (1) | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |
| Steepness of trail (2) | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |
| Condition of vegetation (3) | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |
| Amount of signage (4) | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |
| Information on signage (5) | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |

Q21 What did you think about trail conditions on the Foothills trails?
(Please select one value per condition)

| | **Too many/ too much (1)** | **A lot (2)** | **Expected amount (3)** | **A little (4)** | **None (5)** | **Did not notice (6)** |
|---|---|---|---|---|---|---|
| Bicycle ruts (1) | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |
| Horse/stock tracks (2) | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |
| Horse manure (3) | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |
| Trash (4) | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |
| Dog poop (5) | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |

Q22 What kind of trails were you on?

- ○ Authorized (1)
- ○ Unauthorized (2)
- ○ Both (3)
- ○ Not sure (4)

Q23 What do you think about trailhead infrastructure?

| | Adequate (1) | Inadequate (2) | Did not notice (3) |
|---|---|---|---|
| Toilet facilities (1) | ☐ | ☐ | ☐ |
| Trash cans (2) | ☐ | ☐ | ☐ |
| Information on signage (3) | ☐ | ☐ | ☐ |

Q24 Did you have any conflicts with other users on the trail today?

- ○ Yes (1) _____
- ○ No (2)

Q25 Did you encounter dogs off leash on the trail today?

- ○ Yes (1)
- ○ No (2)

**End of Block: Trail experience**

**Start of Block: Demographics**

Q26 Are you a resident of the Wenatchee Valley?

- ○ Primary resident (more than 6 months of the year) (1)
- ○ Temporary, seasonal, or part time resident (2)
- ○ Visitor or non-resident (3)

Q27 What is your zip code? (Please type primary residence zip code into box, or country of residence if you live outside the US)

- ○ Zip code (1) _____

Q28 What is your gender?

- Male (1)
- Female (2)
- Non binary (3)
- Prefer to self-describe (4) _____
- Prefer not to answer (5)

Q29 What is your age?

- 18-25 (1)
- 26-35 (2)
- 36-45 (3)
- 46-55 (4)
- 56-65 (5)
- 66+ (6)

Q30 How do you identify your ethnicity? (choose all that apply)

- African-American (1)
- Asian/Pacific Islander (2)
- Caucasian (3)
- Latino/Hispanic (4)
- Native American (5)
- Other (6) _____
- Prefer not to answer (7)

Q31 What is your total household income?

- ○ Up to $25,000 (1)
- ○ $25,001-50,000 (2)
- ○ $50,001-75,000 (3)
- ○ $75,001-100,000 (4)
- ○ $100,001+ (5)

**End of Block: Demographics**

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**Start of Block: Comments**

Q32 Do you have any other comments about your trail experiences or suggestions for the Foothills trails?

_____
_____
_____

**End of Block: Comments**

# Appendix B. Results Tables

Table 2. Gender (n=322).

| Gender | Count | Percent |
|---|---|---|
| **Male** | 168 | 52.2 |
| **Female** | 153 | 47.5 |
| **Prefer not to answer** | 1 | 0.3 |

Table 3. Age (n=318).

| Age | Count | Percent |
|---|---|---|
| **18-25** | 35 | 11.0 |
| **26-35** | 91 | 28.6 |
| **36-45** | 72 | 22.6 |
| **46-55** | 51 | 16.0 |
| **56-65** | 39 | 12.3 |
| **66+** | 30 | 9.4 |

Table 4. Ethnicity (n=319). Respondents could select multiple categories.

| Ethnicity | Count | Percent |
|---|---|---|
| **African-American** | 1 | 0.3 |
| **Asian/Pacific Islander** | 6 | 1.9 |
| **Caucasian** | 239 | 74.9 |
| **Latino/Hispanic** | 52 | 16.3 |
| **Native American** | 4 | 1.3 |
| **Other/Mixed** | 10 | 3.1 |
| **Prefer not to answer** | 7 | 2.2 |

Table 5. Total Household Income (n=290).

| Income | Count | Percent |
|---|---|---|
| **Up to $25,000** | 27 | 9.3 |
| **$25,001-50,000** | 65 | 22.4 |
| **$50,001-75,000** | 58 | 20.0 |
| **$75,001-100,000** | 52 | 17.9 |
| **$100,001+** | 88 | 30.3 |

Table 6. Residence status (n=322).

| Residency | Count | Percent |
|---|---|---|
| **Primary resident (more than 6 months of the year)** | 283 | 87.9 |
| **Temporary, seasonal, or part time resident** | 14 | 4.4 |
| **Visitor or non-resident** | 25 | 7.8 |

Table 7. Zip code of residence by county (n=295).

| Zip code by county | Count | Percent |
|---|---|---|
| **Chelan County** | 192 | 65.1 |
| **Douglas County** | 65 | 22.0 |
| **Western Washington counties** | 18 | 6.1 |
| **Other Eastern Washington counties** | 7 | 2.4 |
| **Out of state** | 13 | 4.4 |

Table 8. Previous visitors (n=343).

| Used trails previously | Count | Percent |
|---|---|---|
| **Yes** | 317 | 92.4 |
| **No** | 26 | 7.6 |

Table 9. Frequency of use (n=317).

| Use Frequency | Count | Percent |
|---|---|---|
| **4-6 times a week** | 44 | 13.9 |
| **2-3 times a week** | 75 | 23.7 |
| **Once a week** | 55 | 17.4 |
| **2-3 times a month** | 58 | 18.3 |
| **Once a month** | 11 | 3.5 |
| **7-10 times a year** | 17 | 5.4 |
| **4-6 times a year** | 31 | 9.8 |
| **1-3 times a year** | 26 | 8.2 |

Table 10. Number of years visiting the Foothills trails (n=300).

| Number of years | Count | Percent |
|---|---|---|
| **1-2 years** | 78 | 26.0 |
| **3-4 years** | 57 | 19.0 |
| **5-6 years** | 41 | 13.7 |
| **7-8 years** | 22 | 7.3 |
| **9+ years** | 102 | 34.0 |

Table 11a. Presence of dogs (n=330).

| Dogs brought along | Count | Percent |
|---|---|---|
| **No** | 213 | 64.4 |
| **Yes** | 118 | 35.6 |

Table 10b. Number of dogs (n=112).

| Number of dogs | Count | Percent |
|---|---|---|
| **1** | 81 | 72.3 |
| **2** | 26 | 23.2 |
| **3** | 5 | 4.5 |

Table 10c. Dogs on leash (n=116)

| Dogs on leash | Count | Percent |
|---|---|---|
| **Off leash** | 36 | 31.0 |
| **On leash** | 80 | 69.0 |

Table 12. Motivations for visiting the Foothills trails (n=338). Respondents could select up to three responses.

| Motivation | Count | Percent |
|---|---|---|
| **Exercise** | 311 | 92.0 |
| **Appreciate nature** | 219 | 64.8 |
| **Be with friends and family** | 162 | 47.9 |
| **Relax** | 131 | 38.8 |
| **Solitude** | 101 | 29.9 |
| **Challenge** | 97 | 28.7 |
| **Exercise my dogs** | 89 | 26.3 |
| **Explore a new place** | 76 | 22.5 |

| | | |
|---|---|---|
| **Try a new activity** | 14 | 4.1 |

Table 13. Activities (n=340) Respondents could select multiple responses.

| All activities | Count | Percent |
|---|---|---|
| **Hike/Nature walk** | 299 | 87.9 |
| **Mountain bike** | 129 | 37.9 |
| **Trail run** | 126 | 37.1 |
| **Horseback ride** | 7 | 2.1 |
| **Other** | 4 | 1.2 |

Table 14. Primary recreation location is Foothills (n=339).

| Primary Recreation Location | Count | Percent |
|---|---|---|
| **Yes** | 184 | 54.3 |
| **No** | 155 | 45.7 |

Table 15. Passes for other recreation areas (n=277).

| Passes | Count | Percent |
|---|---|---|
| **Discover Pass** | 250 | 90.3 |
| **NW Forest Pass** | 129 | 46.6 |
| **National Park** | 80 | 28.9 |
| **Sno Park** | 30 | 10.8 |
| **Other** | 12 | 4.3 |

Table 16. Contact organization (n=160). Respondents could list more than one organization.

| Organization | Count | Percent |
|---|---|---|
| **Chelan-Douglas Land Trust** | 114 | 71.3 |
| **City of Wenatchee** | 5 | 3.1 |
| **Wenatchee Outdoors** | 3 | 1.9 |
| **Washington Trails Association** | 3 | 1.9 |
| **Evergreen Mountain Biking Association** | 2 | 1.3 |
| **Run Wenatchee** | 2 | 1.3 |
| **Other/look up online** | 31 | 19.4 |

Table 17. Specific visit activity (n=330).

| Activity | Count | Percent |
|---|---|---|
| **Hike/nature walk** | 202 | 61.2 |
| **Mountain bike** | 70 | 21.2 |
| **Trail run** | 51 | 15.5 |
| **Horseback Ride** | 1 | 0.3 |
| **Other** | 6 | 1.8 |

Table 18. Party size (n=305).

| Number of individuals | Count | Percent |
|---|---|---|
| **1** | 119 | 39.0 |
| **2** | 110 | 36.1 |
| **3** | 38 | 12.5 |
| **4** | 20 | 6.6 |
| **5** | 4 | 1.3 |
| **6** | 7 | 2.3 |
| **7** | 3 | 1.0 |
| **15+** | 4 | 1.3 |

Table 19. Trip length (n=330).

| Amount of time | Count | Percent |
|---|---|---|
| **Less than an hour** | 36 | 10.9 |
| **1-2 hours** | 242 | 73.3 |
| **3-4 hours** | 48 | 14.6 |
| **5-8 hours** | 4 | 1.2 |

Table 20. Authorized or unauthorized trails (n=322).

| Trail type | Count | Percent |
|---|---|---|
| **Authorized** | 278 | 86.3 |
| **Unauthorized** | 2 | 0.6 |
| **Both** | 21 | 6.5 |
| **Not sure** | 21 | 6.5 |

Table 21. Opinions on trail conditions (n varies by specific condition, see table).

| Condition | Excellent | | Good | | Average | | Poor | | Terrible | | Did not notice | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Count | Percent | Count | Percent | Count | Percent | Count | Percent | Count | Percent | Count | Percent |
| **Width (n=321)** | 101 | **31.5** | 149 | **46.4** | 49 | **15.3** | 14 | **4.7** | 3 | **0.9** | 5 | **1.7** |
| **Steepness (n=312)** | 87 | **27.9** | 166 | **53.2** | 45 | **14.4** | 9 | **2.9** | 1 | **0.3** | 4 | **1.3** |
| **Vegetation (n=311)** | 84 | **27.0** | 142 | **45.7** | 70 | **22.5** | 10 | **3.2** | 3 | **1.0** | 2 | **0.6** |
| **Amount of Signage (n=311)** | 56 | **18.0** | 94 | **30.2** | 70 | **22.5** | 59 | **19.0** | 17 | **5.5** | 15 | **4.8** |
| **Information on Signage (n=307)** | 61 | **19.9** | 94 | **30.6** | 78 | **25.4** | 41 | **13.7** | 15 | **4.9** | 18 | **5.9** |

Table 22. Opinions on trail conditions (n varies, see table).

| Condition | Too much/too many | | A lot | | Expected Amount | | A little | | None | | Did not notice | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Count | Percent | Count | Percent | Count | Percent | Count | Percent | Count | Percent | Count | Percent |
| **Bicycle ruts (n=303)** | 17 | **5.6** | 25 | **8.3** | 84 | **27.7** | 65 | **21.5** | 70 | **23.1** | 42 | **13.9** |
| **Horse tracks (n=303)** | 14 | **4.6** | 9 | **3.0** | 47 | **15.5** | 83 | **27.4** | 96 | **31.7** | 54 | **17.8** |
| **Manure (n=301)** | 10 | **3.3** | 7 | **2.3** | 42 | **14.0** | 83 | **27.6** | 115 | **38.2** | 44 | **14.6** |
| **Trash (n=302)** | 5 | **1.7** | 8 | **2.7** | 23 | **7.6** | 63 | **20.9** | 167 | **55.3** | 36 | **11.9** |
| **Dog poop (n=317)** | 10 | **3.2** | 16 | **5.1** | 47 | **14.8** | 100 | **31.6** | 107 | **33.8** | 37 | **11.7** |

Table 23. Trailhead infrastructure (n varies).

| Amenity | Adequate | | Inadequate | | Did not notice | |
|---|---|---|---|---|---|---|
| | Count | Percent | Count | Percent | Count | Percent |
| **Toilets (n=315)** | 221 | **70.1** | 47 | **14.9** | 47 | **14.9** |
| **Trash cans (n=310)** | 195 | **62.9** | 50 | **16.1** | 65 | **21.0** |
| **Information on signage (n=305)** | 210 | **68.9** | 60 | **19.7** | 35 | **11.5** |

Table 24. Conflict (n=316).

| Conflict | Count | Percent |
|---|---|---|

| | | |
|---|---|---|
| **No** | 305 | 96.5 |
| **Yes** | 11 | 3.5 |

Table 25. Encounters with off leash dogs (n=319).

| Dogs off leash | Count | Percent |
|---|---|---|
| **No** | 215 | 67.4 |
| **Yes** | 104 | 32.6 |